

SCIENTIFIC AMERICAN

SUPPLEMENT. No. 1322

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Scientific American, established 1845.
Scientific American Supplement, Vol. LI, No. 1322

NEW YORK, MAY 4, 1901.

Scientific American Supplement, \$5 a year.
Scientific American and Supplement, \$7 a year.

HOW ART IS APPLIED TO INDUSTRIAL TRAINING IN PHILADELPHIA.

By J. A. STEWART.

PHILADELPHIA boasts the pioneer art-textile educational institution in America. But it is safe to say that few even among its most intelligent residents and visitors are aware of the importance and value of the unassuming and effective work going on there—a work which may equally claim the attention and interest of tourists with the Mint or Independence Hall.

The instructed visitor will not fail to look on Broad Street not far from the city buildings for the yellow Corinthian portico which marks the front entrance of this fine institution—the Philadelphia School of Industrial Art. The establishment is large and consists of the main building fronting Broad Street, two extensive four-story brick wings extending the entire

length of the block, and an annex on Spring Garden Street.

The munificent gift of \$100,000 by Mr. William Weightman and the generous response of the public of Philadelphia to an appeal for assistance, by which a like amount was raised by popular subscription during the spring of 1893, enabled the institution to acquire the magnificent property at the northwest corner of Broad and Pine Streets, which it occupies at present.

This property, with 200 feet frontage on Broad Street and 400 feet on Pine Street, is most spacious and advantageous, situated as it is in the very heart of the city.

The Philadelphia School has many claims to public attention. In its evolution it represents a radical form of the movement against a purely classical training. It is in line with what is considered the most important advance

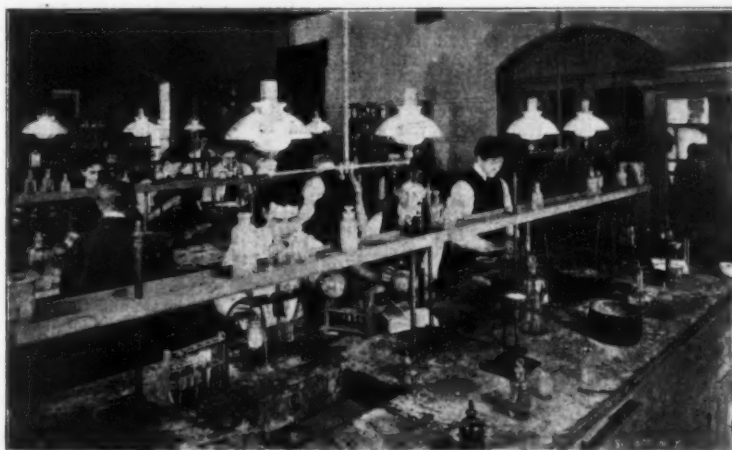
in methods of instruction which has been made by the age in which we live—the application of art and science to the needs and purposes of human kind.

The purpose of this institution of art as defined by its charter is distinctly industrial. Not only the instruction in the school but also all the collections for the Memorial Museum in connection with it are as largely as possible illustrative of the application of art to industry.

One is impressed with this salient fact immediately on crossing the threshold of the well-appointed and finely equipped building. The broad, handsome, well-lighted vestibule is decorated by evidences of the students' taste and skill in plaster, tiling, metallic work, and mosaic. Artistic motives gleam from walls, doors, and mantels in the various apartments devoted to



SCHOOL OF INDUSTRIAL ART, PHILADELPHIA, PA.



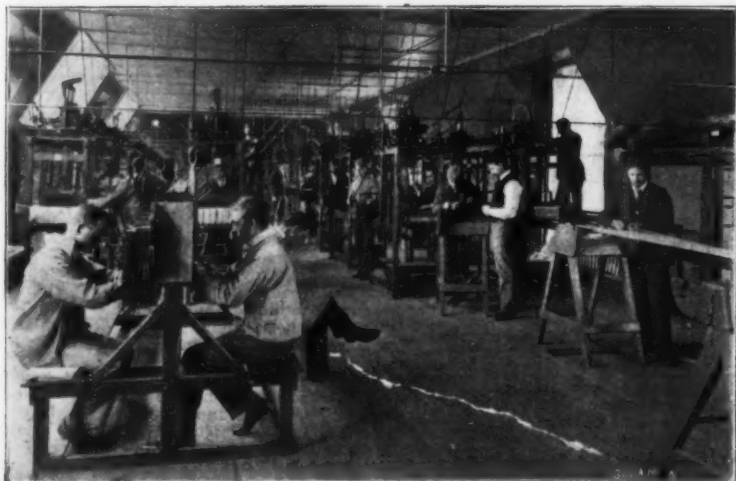
LABORATORIES OF CHEMISTRY AND DYEING.



DESIGNING ROOM.



CLASS IN MODELING.



WEAVING CLASS—HAND LOOMS.



CLASS IN DECORATIVE PAINTING.

study and design. The students' work is constantly called into requisition in useful and purposeful application.

In the interesting exhibit room which occupies a commodious apartment in the right wing, it is fully shown that this idea has never been lost sight of. The model is posed not merely as an academic study, but with reference to some feature of definite application, as filling a spandrel or illustrating an idea. The ideas are all worked out with a view to their adjustment to an end. It is pointed out to the interested visitor that the student has consequently made in every department a model and not a drawing—theory being accompanied by practice in producing plaster casts, mantel-pieces, Florentine chairs, figure for a lectern, etc. The designs are worked out as they would be for the shop, mill, or factory, not being the idea only, but the real thing that is wanted for serviceable use.

Designs are worked out in stained glass, a person who has a shop of this kind being the instructor. In book binding, books are made and decorated. These garden vases are samples of potter's work done on the potter's wheel right here in the school. An original design of a fire-stove with Indian motives is seen in this superb mantel-piece. The modeling, it is evident, also is constantly with the end in view of making artistic things. Importance is attached to the size, for making big things is encouraged as better than making little things. No one of course will deny that the educational principle of constructing an object with one's hands is superior to merely thinking it out on a flat piece of paper.

The textile school is a co-ordinate division of the school of art and draws its inspiration and strength from it. While the Philadelphia Art School proper was inaugurated in 1877 as a result of the Centennial Exhibition, the School of Applied Design, the School of Wood Carving, and the School of Textile Design and Manufacture were not added till 1884. It may be looked on as a significant and encouraging fact that the first American textile school was started in connection with a school of art. And this was done, it is to be noted, in recognition of the dominating purpose of the school that only by familiarizing students with the processes of manufacture and industrial application of design could the proper direction be given to such purely artistic training as the school had to offer.

The Philadelphia School of Textiles, which has served with European schools as an incentive to our later New England and Southern textile institutions, owes its inception to the first textile manufacturers' association, which was formed in Philadelphia in 1880. The school, as has been stated, was started in 1884. Chief among its promoters is Mr. Theodore C. Search, president of the textile association, as well as president and chairman of the committee of instruction of the permanent Museum and School of Industrial Art.

The school owes much of its progress and success to its able director, Dr. L. W. Miller, a native of New England, who has been at its head since its beginning. Dr. Miller, it is pertinent to note, was a member of the first class ever entered in the Boston Normal Art School. He was a teacher of drawing in Salem Normal School, Quincy Academy, and the Boston public schools before his removal to Philadelphia in 1880.

The Philadelphia Art School, at first only a modest drawing school in rooms of the Franklin Institute, has grown under Dr. Miller's direction and has expanded wonderfully under the developing power of the principle of making the application of art to industry a real thing. The staff now includes a score of able women and men, chief among whom is Mr. E. W. France, a graduate and director of the Textile School. Seven hundred individual students are enrolled, with 800 classes of all sorts. The tuition fee is \$150 and there are numerous scholarships. There are evening classes for operatives and classes for teachers on Saturdays. The school recognizes the disadvantage of the city boy (who by nature of his environment is deprived of the objects of nature which delight and inform the country boy) and opens its rooms to children on Saturdays.

The Textile School has been continually enlarging. The department of chemistry and dyeing was added in 1887; that of wool carding and spinning and cloth finishing in 1894; and that of cotton carding and spinning in 1896. The school has received endorsement by State appropriation and by commendation in reports of the United States Government, of the Secretary of Internal Affairs of Pennsylvania, of textile associations and of manufacturers who liberally support it.

The institution is a notable representation of the idea of bringing shop and mill into the school, and of the association of art studies in their application to fabrics, embodying a knowledge of the fabric and everything that goes into it from raw material to finish. Form, material, skill and taste are consequently all objects of instruction. The student takes the raw material, the fiber of wool, cotton, silk from cocoon, and follows it by every step of preparation through carding, spinning and weaving. To the visitor it looks as if no building could be better equipped for its purpose than this commodious, well lighted structure with its various apartments for machinery, lecture rooms, study and recitation rooms, and laboratories. Here are the light cotton-loom with its filling magazine and warp-stop motions, the different looms for silk ribbons, cotton fabrics, worsteds and woollens, dress goods, and union fabrics, and the large, cumbersome carpet-loom. In a separate room are the hand-loom, where the student may take his design and produce the result by his own effort.

The economical questions that go into the practical management of mills, the calculations of sort and different kinds of material and machinery are just as much subjects of study as the aesthetic, in accordance with the fundamental principles of the school that the student needs to make not only designs but things. Instruction in the chemistry of bleaching and dyeing, of oils and soaps is as complete as for the processes of spinning, carding and weaving. And drawing and designing, it goes without saying, are an integral part of the textile instruction. "The idea being," says Dr. Miller, "that the designer should be the brain of the establishment and should know what economy as well as efficiency in administration means.

He should be able to buy and to know what he is getting."

Though evening classes are held for operatives, the students at the Philadelphia Textile School are largely college men, and future masters of the trade. It is not surprising in view of the grasp of ideas and principles afforded that its graduates go at once into commanding positions in industrial enterprises. It is a good augury, too, for the future of the textile manufacturers that such a school as this has taken more than 600 pupils of American grammar schools and high schools and graduated them in the course of textile design.

AMERICAN ENGINEERING PROGRESS.*

IV. THE HUMAN FACTOR.

THE chief difficulty in dealing with a problem so large as that comprised within the subject-matter of these articles—which form the complement of those on "American Engineering Competition" published in The Times last spring—is to bring the business to a conclusion. As one writes, new vistas open up, undiscussed influences emerge into prominence, and one subject suggests another, each incomplete without what appears to be its corollary. The only cure for literary elephantiasis, engendered by such a state of affairs is the knife; and, as this is the twentieth instalment of the combined series, it is well the operation should be performed. No doubt this will involve leaving out many points which will seem of first importance, especially to those most affected by them; "the key to the situation" always fits one's own lock.

The evil influence of militant trade unions has been, I think, amply shown by the examples given in the two concluding articles of the series on "American Engineering Competition;" and, therefore, this aspect of the question need not be gone into again in detail, important though it is. It may be well to repeat, however, that the great engineering strife of over two years ago did much to modify the aggressive attitude of the union leaders. But it is impossible to change habit engendered by long years of use, which, we know, is second nature. The American "hustler" from his boyhood, almost from his babyhood; the Briton plods. It is a detail that the American workman hustles for ten hours a day; the Briton plods, so far as popular opinion and shop stewards allow, for nine.

While referring again to the labor problem I should like to add a word of explanation regarding the question of piecework. In an editorial article The American Machinist, of New York, takes me to task, very courteously, for the prominence given in the former articles to piecework as adopted in the United States workshops. What was written was the result of observation. I found piecework methods being followed out on a scale and in a spirit of harmony between employers and workmen that are rare in this country. The article in the American paper says: "We are aware that among machinists, at any rate, piecework is as unpopular here as it is or can be anywhere." The American Machinist is a journal of such high authority in these matters that it would be an omission not to notice this correction. The piecework system is by no means an ideal method of adjusting wages, but if employers follow it in a spirit of wise liberality it will work well enough. A member of the editorial staff of The American Machinist has, however, worked out a system of adjustment of wages which aims at rewarding the workman according to his merits without incurring the disadvantages incidental to piecework remuneration. I found this system in use at one or two large engineering works, where it was said to be acting most satisfactorily.

These matters, however, are details; the end is to encourage merit and reward effort. In this the American engineering employer, much to his own advantage, is more successful as a rule than the average Briton. No doubt the explanation is to be found largely in the general conditions by which the unions have here governed employment of labor; but the same conditions would have overtaken the American employer had he displayed less foresight.

Another point in which average American employers appear to display more wisdom—although this may be doubted by some—and more fairness—which can hardly be questioned—is the way in which they remunerate young persons. In the engineering trade in England the scale of pay of a young man is largely governed by his age. I am not now speaking of apprenticeship, which is a thing apart, and in any case is now far different from the apprenticeship of past times, when a youth was taught a craft. I have now in mind more especially those, from technical colleges and elsewhere, who are at the beginning of their career, who are striving to gain a footing in their profession or calling, either in the drawing office, in the testing department, or in some position in the shops where a knowledge of scientific methods is needed. It is the practice in this country to pay these beginners wages altogether insufficient for the value of the work they perform. A young man, at the age of twenty or twenty-one, may have passed with credit through a college course, on which his parents may have spent three or five hundred pounds, yet the best, may be, that he can do is to get a berth in a drawing office. An ordinary mechanic has three times his wages, and yet has no appearance to keep up. Of course, some young men fresh from a technical college are worth very little; they have no practical experience, and their conceit often stands in the way of their acquiring it. But a large proportion are sensible young fellows enough, with a knowledge of scientific principles that far exceeds that of their seniors, and have a sound, even though academical, acquaintance with shop practice. Such knowledge rapidly ripens into working efficiency of a high order, founded as it is on a wide basis. These are the coming engineers, the future leaders upon whom the country should depend to carry on the struggle with foreign rivals; but they too often receive scant encouragement. I have in my mind a past instance of one accomplished graduate of a technical college who entered the drawing office of a large engineering firm at a salary of ten shillings a week. The head draughtsman was one of the old school—a good man in his time

and efficient enough in his own line, but working wholly on precedent. It became necessary to tender for work involving a new branch of engineering. In preparing the plans and estimates, a knowledge of mathematics and of certain scientific principles was needed. As the task was a good deal beyond the empirical methods of the original staff, the new junior draughtsman was put on to the work. The contract was secured and successfully carried out, resulting presumably in a handsome profit for the firm; at any rate, it filled their shops for a time. Now, if the designs had not been made in the office it would have been necessary to send to certain professional gentlemen about Westminster for assistance, and this would doubtless have cost a sum running well into hundreds of pounds. The reward the young ex-student received—including that for his overtime, which was considerable—was a rise of a few shillings a week at the end of six months.

No doubt the case above quoted is an extreme one, but it is not so exceptional as might be thought by those outside the business. It may be said the young man was foolish not to stand out for better terms. He was not so foolish as might appear. His parents were able to make him an allowance, so he worked eighteen months for the sake of experience and then went abroad, where he is now designing machinery, and has been instrumental in taking many orders from British firms—among others, the firm that had not the good sense to pay him according to his work rather than according to his age. In America there are hundreds of young men of this class; one meets Englishmen everywhere in the best positions, doing the best work, in the office and in the workshop. It is a great gain to the United States, and a great drain on the United Kingdom. A child is born in England, say of superior working-class parents, is nursed, fed, clothed, and educated, perhaps for twenty years. Making a rough estimate of £15 to £20 a year all through, the cost to the country of a young artisan has been £300 to £400, less of course any useful work he may have done; and this efficient instrument of production we present to the United States. There is, however, a great deal more than this in the transaction. The most enterprising are those who seek their fortunes abroad; a man does not venture unless he feels he is capable; moreover, the United States have a way of making far more out of him than we do.

For the engineer, the more-educated man, the case must be put higher. If we allow that up to the age of twelve the cost of a middle class child is £25 a year, from twelve to seventeen £50 a year, and from seventeen to twenty £100 a year (I have purposely put the figures low) we have 300 + 250 + 300 = £850. Probably the young engineer will not go abroad for another five years, but will enter works at home. For these five years he will be doing useful work, and though he seldom gets paid for it—at any rate, only to a trifling degree—it all counts as an asset to the country. Still it is, as a rule, only when the young man—and this applies to both mechanic and engineer—has reached his maximum value that we hand him over to our chief trade travel. We may have paid America for corn to feed him and cotton to clothe him; his sugar came from Germany, his tea from India, his beef from America, his mutton from Australasia, his cheese also from America; there is not fifty per cent of him that is British produce; more than half has been bought and paid for. And yet we send him away, duty free, to make lathes, or bicycles, or rails, or agricultural implements to drive us out of our ancient markets.

Another evil springs from this habit of underpaying young engineers—it narrows the field of selection. A man—say a draughtsman at three or four hundred a year—has a son who shows a talent for engineering, and the father naturally would like his son to follow his own calling. He could face the cost of the technical college, and might support the lad up to the age of twenty. But he knows how difficult it is for young men to earn a salary at first, and so puts the boy into an office or in some other position where the return will be more immediate. No doubt many a future engineer has been lost to the country in this way. Of course there is no help for it, or no help that Lords and Commons can give, nothing that legislation can do. But the engineering employers individually can do much—in fact, can do everything. If they would be wisely selfish, instead of foolishly selfish—I make no useless plea for altruistic considerations—and would try to keep at home, by adequate pay and prospects, the bright young men the country has never failed to produce, such employers would benefit their own business first and the business of the nation into the bargain. As I sit here I really believe I could, if I had time enough, make out a list—not by any means wholly English—almost as long as a column of The Times of firms who have achieved success by fairly recognizing and rewarding merit in those they employ; and I am sure another list equally long could be made of those that have fallen behind from the opposite cause. It stands to reason if one thinks a little. A big manufacturing business is not the work of one man alone. Of course, one man is paramount; but he must, however able, depend upon assistants for much of the executive work.

Almost on the last day of the past year there died a man who built up a gigantic business and accumulated an enormous fortune by his own genius. Perhaps his most essential characteristic was the wise liberality with which he treated those who worked with him. Lord Armstrong laid the foundations of what was at first a modest engineering establishment by his native talent as an engineer. As Elswick grew he had to transfer some of the management, first to one and then to another. Had he had the limited intellectual horizon of many he would have kept a larger share of the profits to himself and concluded that a few hundreds a year was sufficient pay for departmental work. Probably he would then have died years earlier a comparatively unknown man.

Big salaries are not enough. One need not take a very cynical view of human nature to believe that a man does his best when he knows reward will be proportionate to achievement. To get his heart in the work you must scale wages against product, not against the number of hours since last pay-day. Most employers say it is impossible to do this. They shy at the obvious difficulties near by, not seeing the solid advan

* We are indebted to the London Times for this interesting article.

tages ahead. Some try to get round the question by a bonus. It is generally a poor substitute, and often works more harm than good.

A passing reference by way of reminder must be made here to the influence of "Great George Street" and government inspection, but there is less need to dwell on this aspect of the question as it has already been referred to in my former articles. The tests imposed by consulting engineers of Great George Street, and by government authorities, are a great bar to cheap and efficient production. The position of the consulting engineer—or the engineer, as he would describe himself, as opposed to the contractor—is perfectly easy to understand. He has not to pay for the thing produced, and has no interest in its being produced cheaply; in fact, his interest is often quite in the opposite direction. But, as designing and inspecting authority, he is responsible for the stability and safety of the structure; and he therefore devotes his energies chiefly to making sure that no untoward incident shall occur. Thus it is we have factors of safety imposed which are altogether out of reason, structures erected that are massive and costly beyond any possible need, and rejection of material for microscopic defects that could have no practical influence on work. The consulting engineer and the government inspector will run no risk. Thus it is that other countries, where the system has not grown to such lengths, are often able to undersell the British manufacturer and contractor. Even safety may be bought at too dear a price. The position is a difficult one. A foreign railway wishes to buy a plant in Great Britain, or a local authority at home proposes erecting, say, a dam for waterworks. They are not competent to deal with the technicalities of the subject themselves. They, therefore, go to the independent authority for advice and protection against the possible carelessness or dishonesty of the contractor. That is business-like and sensible in theory, but somehow it does not work out well for the trade of the country. The consulting engineer does not specialize enough. Bridges, locomotives, steel rails, railway carriages, buildings, all come alike to him. Naturally he cannot keep abreast of the times in every branch of engineering. The way in which the improvements of the last few years in the manufacture of steel have been ignored in drawing specifications are instances in point. Again, the consulting engineer is often too much an office man; he has left the doing of the work to the contractor. He lacks knowledge of detail; and ignorance is always timid. Hence come opposition to advancement and ridiculously severe tests.

In America contractors are doubtless better off. There they have some consulting engineers, mostly designers of important structures which are out of the common run by reason of their novelty or magnitude. There are also certain consulting engineers who are chiefly inventors, and who work largely for the manufacturers. There is, however, comparatively little pure "Great George Street." Whether buyers trust contractors more, or whether contractors have been strong enough to make their own terms, or whatever the reason is, it has resulted in giving the American manufacturing engineer an advantage over his British competitor. Of course, there is a set-off for us. If the foreign buyer wishes to be as immune against accident as anything human can be and does not mind paying for it, "Great George Street" is his best policy.

I know I shall be accused by some of leaving out the Prince of Denmark in not discussing railway freight-rates and shipping-rings; but the matter relating to them is so voluminous that I can do no more than say that these matters have had, and appear still more likely to have in the future, an important and detrimental influence on British industry. There is also the question of the restriction of apprentices by trade union regulations. When this is combined with a rule preventing a man who is not in the union from working at a trade, the matter becomes very serious, as the due supply of labor is cut off. It is the scarcity of skilled labor which chiefly limits the productive capacity of the country. The reason why engineering contractors have been obliged to refuse orders during recent times has been largely that they are not able to get competent workmen.

In these articles dealing with the American engineering industry and its influence on British trade many matters of detail have been discussed. However important some of these may have been, all seem to me—and the more I have studied the subject the deeper the impression has become—subordinate to one dominating factor. If American blast-furnace practice is more productive than our own; if American steel works are better equipped than our own; if American machine tools are more ingenious than our own; if American electrical plant is commanding even our own market; to whatever we turn we find it is the human factor—character—that commands the situation. Even the rich iron ore of the Lake Superior district, far distant from the place where it is used, has been made available by the ingenuity and enterprise of American engineers and men of business. This thing is patent, and yet, in discussing the problem, we avoid it.

What the conditions are that have brought the present state of affairs about may perhaps be summed up in one phrase—our overwhelming success in the past. We have thought ourselves secure; we have relaxed vigilance and eased the burden. Our young men are kept back until their best energies have run to waste; and we have a system of labor employment which strives, not without success, to keep labor at an average of the lowest level.

It is the wise conception of what will work out to his own advantage which so largely distinguishes the American business man. Such a gift does not come without seeking. It means thinking of business with a concentration of mind that, to the average European, is "phenomenal." To the American business is a science, and he follows it almost with the enthusiasm of a scientific devotee. No risk of personal discomfort is too great; his alertness is never at fault; success does not blunt his devotion. The Briton is educated to a hundred distractions; in America there is practically no leisured class of young men. On leaving school or college they are obliged to take to business of some kind or do absolutely nothing, unless they enter the professions; but these form a narrower

circle than in Europe. The business spirit enters into all conditions of life. There is no keeping it down. It is manifest in the legislature, the army, the navy, in literature, journalism, art, politics, and even more remarkable in the law. In social life the business spirit is always apparent. The American men, still more the American women, never, to use their own expressive phrase, "give themselves away." Lavish in hospitality, generous and emotional as they are, yet if you want the American you must buy him at full price. Impulsive as he is, and great as is his pleasure in giving, yet he never abandons himself so far to that indulgence as to give and regret. That is one reason why America is so pleasant a land to visit.

I would say a final word in explanation or self-protection. The expedition on which these articles were founded was undertaken to discover reasons for American engineering products coming into our markets, and the markets we held abroad, in largely increasing quantities. Naturally that led me to the establishments best equipped in the country, for these were our rivals. That which was inferior did not enter into my plan of operations. The comparison, however, of the best in the United States with the best in Great Britain on my last trip has increased tenfold the opinion I held from previous experience, that in American engineering enterprise we have a rival threatening our industry to an extent that will be most serious, if not disastrous, to the whole trade of the country, unless a change is made in our business methods. It has been said that I can see nothing good in my own countrymen. That accusation is partly answered by the preceding sentences; but I would add that these articles have been confined to strictly business aspects of American life. Whether the American is a more complete man, whether he is more or less agreeable, more moral, stronger, better-looking, or more amiable than the people of other nationalities is a thing with which we have nothing to do here. The perfect business man is not the highest type, although, under modern conditions, he seems likely to become, for a time, the most efficient.

THE IMPROVEMENT OF THE SOUTHWEST PASS.

To the Editor of the SCIENTIFIC AMERICAN:

Having been a patron of yours for many years, I desire to say something about the Mississippi River improvements, and believe that my fifty years' experience on this coast with mud and water may be of public interest.

The problem is to furnish a ship channel through the Southwest Pass to a depth of 35 feet. There is a bar near the mouth of the river, 21 feet deep at the crest, with a decline of, say, one foot in 700, both up and down the bed of the river from the summit and for a distance, say, of 2½ miles each way. The deposit being of silt, sand, mud, and clay chunks, must be removed.

The river is at this point about 1,600 feet wide,



and as the daily tide is only about 15 inches it would not interfere much in retarding the current.

Now, my plan is to use a pump that would give a pressure of from 75 to 100 pounds per square inch, or an air compressor located on the bow of a steamboat, which would supply a receiver of sufficient sized pipe, placed around the prow, with numerous rubber hoses attached, to reach to a depth of 50 feet. The hose would carry nozzles sufficiently heavy to hold the hose to its work. By forcing the air or water down into the sand and moving across the mouth of the river at the 35-foot depth of water a cut could be made as shown in the diagram to a depth of 21 feet, which is the height of the bar. The current, in falling into the cut, would wash away or eat back into and through the bar and force the floating sand, silt or mud out into the deeper water of the Gulf. This would go on until the bar was washed entirely away, and a depth of 35 feet obtained for the full width of the river.

In starting the cut, it would no doubt be advisable to start in at 40 feet—possibly 45 feet depth—and gradually approach the bar. In passing across the mouth of the river, a dozen or twenty rubber hoses would no doubt stir up the bottom to the depth of one to four feet at each passage; and if the current were strong, the debris would float at once into deep water. And as soon as any cut of the grade of the bar was made the current would at once renew the grade on the old line—about 1 in 700—or, in other words, if a foot is taken from the foot of the grade the current will take off a foot from the whole face of the grade on the lower side.

An experiment could be made at little cost by making a cut across the river near the summit of the bar on the lower side where it could be seen that the sand was moving out rapidly after being disturbed.

Suction dredges, such as the government is building, only reach down from thirty to forty feet, and will not assist nature; they will merely make potholes for sediment to lodge in.

I have no official account of the slope beyond the 35-foot depth of water, but I believe that the littoral wash may have produced a steeper grade than 1 to 700, in which case the work would be lighter. In any event to be economical the removal of the sediment must proceed from the Gulf up to the river's mouth, as the main dependence is on the scouring action of the current.

The Eads Company dredged for months at the mouth of the South Pass with little effect, and the reason of their failure was no doubt that they did not dredge far enough out and only to a depth of perhaps 30 feet.

The most favorable time would be when the current was strongest, and probably compressed air would serve better than a force pump with water. Only two things are necessary to make the work effective and economical—first, to stir up the mud thoroughly, and, second, a strong current to carry it away.

By opening the mouth of the river to, say, 75 feet in depth to its full width practically all of the river water would pass out of the Southwest Pass, which now carries about 60 per cent.

I believe that many millions of dollars might be saved by our government annually by a more thorough knowledge of the use of water as a hydraulic force.

R. G. SNEATH.

420 Eighth Street, San Francisco, Cal.

FURTHER REMARKS ON THE ARMAMENT OF OUR NEW ARMORED CRUISERS.

April 23, 1901.

To the Editor of the SCIENTIFIC AMERICAN:

Owing to the importance of the subject I would like to make, with your permission, some further remarks concerning the armament for our new armored cruisers, based upon argument brought forth in your correspondent's article in the SUPPLEMENT of April 20, replying to my criticisms in the SCIENTIFIC AMERICAN of April 6 to the proposition to substitute 7-inch guns for 6-inch guns, as brought out in his first article of March 23.

Your correspondent considers my "first and principal objection" to the substitution of 7-inch for the 6-inch gun to be the lack of intermediate caliber guns. To defend his suggestion he says: "If we consider the latest armored cruisers of the Italian navy in this connection, we find vessels carrying twelve 3-inch rapid-fire guns as a secondary battery to twelve 8-inch rifles."

Very well, we now come to a point where it would be feasible to decide the intermediate caliber question before continuing. To do this let us see what guns the "California" has to cover the fire of the Italian vessel. For four out of the twelve 8-inch guns of the Italian ship the "California" has four to reply, thus leaving the Italian eight 8-inch guns against which our ship could fight fourteen 6-inch rapid-fire guns. The 8-inch guns of the former, not being rapid-fire, would deliver "under conditions of battle," one shot each in at least two minutes, or 125 pounds of metal per minute, to which each of the 6-inch guns of our vessel could deliver at least 300 pounds per minute. Then again the "California" is superior by six 3-inch rapid-fire guns. Should the Italian ship and the "California" ever have occasion to meet in a conflict, the former will sadly feel the lack of sufficient intermediate caliber rapid-fire guns to reply to the hail of shell it would receive from our ship. After our late experience it would be folly to discard such guns just because somebody else has done so.

Your correspondent quotes my second objection as follows: "It is safe to assume that the 6-inch gun will deliver more metal within a time limit," etc., which is incorrectly quoted, and should have read: "It is safe to assume that the latest 6-inch gun," etc., as it appeared in my article; for any 6-inch gun will not fulfill the requirements. The inaccuracy is probably due to oversight. However, to continue, your correspondent further says: "Assuming, then, that the

weight of the 7-inch shot will be about 175 pounds, we find that this weapon is capable of delivering at least 350 pounds of metal per minute as against 300 pounds or the 6-inch gun, and conditions would be favorable to the gunner's attaining the same accuracy with the former as with the latter. Add to this the fact that, owing to the increase in caliber, the 7-inch gun will have greater range and much more power than the 6-inch, and it will easily be seen that the advantage is overwhelming in favor of the 7-inch weapon."

It would be well to consider this point for a moment before accepting such a hastily drawn conclusion. From the above it is to be inferred that your correspondent could fight the 7-inch guns when the 6-inch guns are out of range and with the same accuracy. I still doubt the possibility of the 7-inch gun to be as easily and accurately handled as the 6-inch gun, for the reasons given in my article of April 6, but will make a temporary assumption to that effect, in order to be on the same ground with your correspondent. Now, this being the case, the 7-inch gun will be just as accurate as the 6-inch gun at close range; it will be just as accurate at the long range of the latter, but as soon as it is trained beyond the fighting range of the 6-inch gun it no longer remains as accurate, but becomes more and more inaccurate or difficult to handle according as the range increases beyond that of the 6-inch gun. From this it will be seen that the advantages to be derived from the increased range of the 7-inch gun cannot be associated with the accuracy of the 6-inch gun.

Regarding rapidity of fire, your correspondent quotes the following from my article: "What overwhelmed the Spanish gunners was not the accuracy of our fire, far from it—only from two to three per cent of the shots taking effect; it was the rapidity of our fire that filled the air with shell that demoralized them."

Commenting upon this he says: "Permit me to say that I very much doubt if the hostile gunners either at Manila or Santiago cared two figs for all the shot which were limited in their death-dealing mission to puncturing the surrounding atmosphere. . . . The lessons of 1812 and 1898 have amply demonstrated the fact that it is not the shots that don't hit, but those that do hit, that win the battle."

In connection with the latter (1898) I would refer your correspondent to the "Proceedings of the United States Naval Institute," No. 90, page 384, par. b, and to the table of hits on page 395, par. 15. Also to Spears' "History of Our Navy," Vol. V., pages 443-444, the last sentences of which read: "We made no more than three effective hits out of a hundred shots. And only two of our largest shots hit at all. What would we say of a trap-shot who killed but three birds of a hundred?" I further refer him to "The Spanish-American War," War Notes Series no. vii., pages 127-128.

The following is quoted, which your correspondent

says "is taken from the editorial page of your issue of December 22, 1900, from an article entitled 'Report of the Chief of the Bureau of Ordnance':"

"Time was when the 6-inch gun was more than a match for the light armor carried by the cruiser class, but to-day it is questionable whether the 6-inch shell will have, at the ordinary fighting ranges, sufficient penetrative power to get through the Krupp plates of the modern cruiser. The 7-inch or 7½-inch gun combines something of the penetrative power of the 8-inch with much of the handiness of the 6-inch weapon, and we confidently look to see it adopted as one of the standard guns of the navy."

Although this quotation appears in the editorial referred to, it does not appear in the "Report of the

of trips by diminishing the number of locks; nor should we forget the invention of lifts for canals, which are certainly marvels of modern engineering. But we have too long employed, if not upon rivers, at least upon canals, the antiquated method of towing by horse or man that is accomplished very slowly and diminishes the capacity of the waterways upon which it is practised. In a legitimate enthusiasm for the engine, however, we must not exaggerate things and imagine, for example, that the solution of the problem is very easy from a mechanical viewpoint, or that the primitive towing to which allusion has been made is absolutely ruinous to the industries. In reality, with well-organized sets of horses and drivers, it is certain that the carriage of one ton to the mile may be effected at quite a small expense. This was well shown by M. Max de Nansouty, in a study of the system of electric towing installed by Messrs. Galliot and Deneffe upon certain canals of the North of France.

Nevertheless, mechanical traction and propulsion have such advantages that the efforts of engineers are multiplying in this direction. In this connection we would call attention to a very interesting arrangement devised in England by Mr. H. Barcroft, of Newry, and which has been adopted upon certain navigable

erators that can be easily put in place, that has a heating surface of 80 square feet and weighs 2,600 pounds. The steam is led by a pipe, which passes under the feet of the pilot, to a horizontal motor with two cylinders of a diameter of 4.5 inches and a stroke of 8. The motor is installed upon the deck directly in front of the sternpost. On each side, coupled to the crank shafts, are two toothed wheels 12 inches in diameter which control analogous wheels, but the number of teeth of which is double that of the preceding and which are placed upon vertical shafts fixed in the stirrups (already mentioned) at the stern of the boat and beneath the screws.

These vertical shafts terminate beneath in a bevel wheel that meshes with a toothed wheel secured to the boss of each screw. The role and function of this transmission, which assures of a proper starting of each screw, may be easily understood. The bosses of the screws are arranged like the hubs of carriages with a lining of leather and constant lubrication. In consequence of the play of the gears and the respective number of the teeth of the wheels, the propellers have a velocity which is only half that of the motor.

The two propellers revolve in opposite directions. Their diameter, which is 60 inches, may appear excessive, but is explainable by the fact that they are

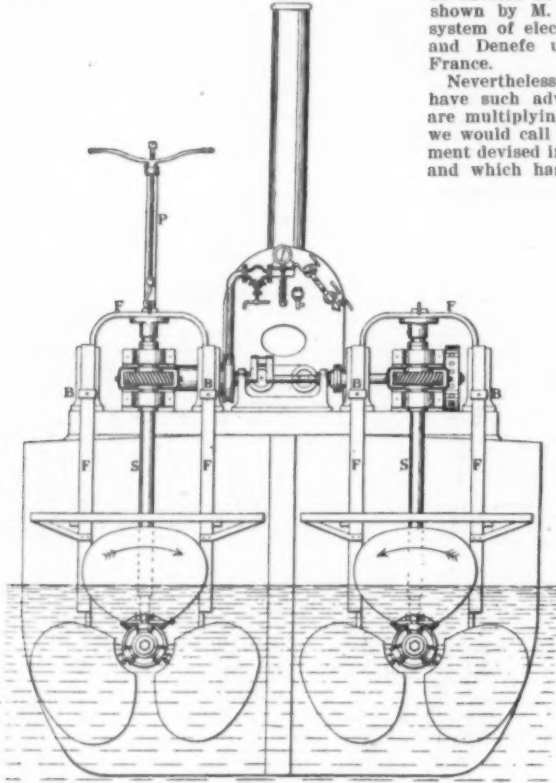


FIG. 1.—ARRANGEMENT OF PROPELLING APPARATUS OF THE SCREW BARGE.

Chief of the Bureau of Ordnance" and cannot therefore be considered as representing the views of the Bureau, as might be inferred.

Your correspondent is loth to give up the 8-inch gun on the ground that it would be extremely unwise. He persists in having the 7-inch gun, which "combines something of the penetrative power of the 8-inch with much of the handiness of the 6-inch weapon." Permit me to ask him why he persists in retaining two calibers when the smaller one has more than all the advantages of the larger?

From this I do not wish to be considered as opposed to the 7-inch gun for naval use; on the contrary, such a gun is to be gladly welcomed, although it would have to be accompanied by an intermediate caliber rapid-fire gun. In assigning its use, however, everything ought to be taken into consideration.

CARLOS DE ZAPATA.

118 West 44th Street, New York, N. Y.

SCREW BARGES.

WHILE the means of land conveyance are improving, especially through the progress making by railroads,

waterways of the United Kingdom. Let us remark that this system has certain characteristic advantages that render it very valuable. In the first place, it gives the barges upon which it is installed the advantage of the excellent rendering of a screw as a propeller, but a screw of which the mounting at the stern does not reduce the load-capacity of the boat, and which is nevertheless so arranged that the water has easy access to it.

On another hand, the Barcroft system does not unnecessarily encumber the barge during the process of loading, since it is put aboard at the very moment that a start is to be made. Every barge is completely independent and possesses its own motor, and it is therefore no longer necessary to form convoys. It is unnecessary to say that after the apparatus has been put on board it in nowise interferes with the passage of the boat through locks or under bridges, and that it does not, through its weight, sensibly diminish the carrying power of the boat. Finally, the motion of the propeller blades is so gentle that it does not injure the banks of the canal.

An examination of the accompanying figures will allow the system to be easily and quickly understood.

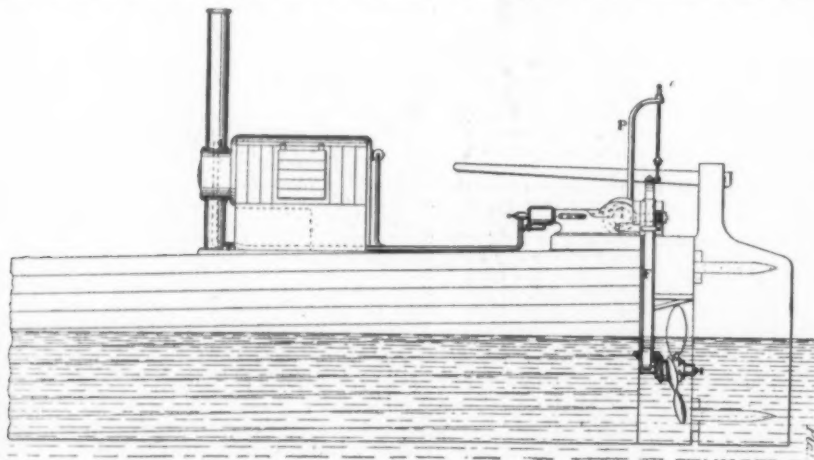


FIG. 2.—LATERAL VIEW OF THE SYSTEM OF PROPULSION.

conveyance by inland waterways has long remained in a primitive state in some countries.

Doubtless we ought not to forget the deepening of canals, the regulation of the flow of numerous watercourses, and the invention and construction of high-fall sluices that permit of shortening the length

The two screws are put in place, at the moment desired, on each side of the rudder, and are suspended, in great part projectingly, from stirrups, and surrounded by cages to protect them from accidental shocks and floating plants. They are actuated by a motor which receives its steam from a movable gen-

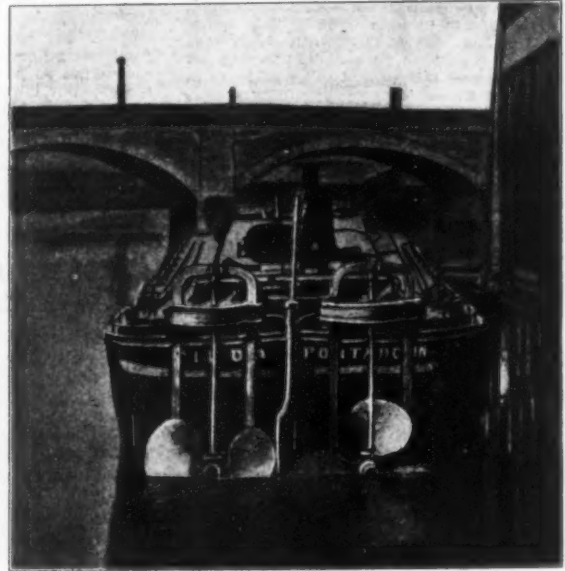


FIG. 4.—THE SCREW BARGE—FROM A PHOTOGRAPH.

designed to operate only partially submerged. They are provided with three blades, each of 3 square feet surface, and are made of thin steel. Their arrangements have been carefully studied with a view to respond to the well-known principle of the illustrious Rankine, viz., that the best propeller is that which forces the greatest volume of water possible to the rear, but at the least velocity. The pitch of the blades is such that they make 1,000 revolutions to the mile, and, at full speed, 100 revolutions per minute.

The rudder bar in use upon the barges has had to be slightly modified by giving it the form of a swan's neck in order to allow it to pass over the motor. Moreover, a long screw permits of lowering the propellers so as to submerge them as deeply as possible. As for the running of the motor, that is so simple that it might be intrusted entirely to the helmsman, especially since the way is generally clear in canals. Nevertheless, the pilot usually has an assistant to look after the boiler and to mind the helm when he himself desires to attend to the motor.—For the above particulars and the engravings we are indebted to La Vie Scientifique.

TUNNELING A MOUNTAIN FOR WATER.

By ENOS BROWN.

OVERLOOKING Santa Barbara Channel and bounded for the mile and three-quarters of its width by the Pacific Ocean lies Hope Ranch, the property of a wealthy syndicate and one of the most beautiful locations in all Southern California. Originally purchased as a site for a watering place, it has all the requisites to

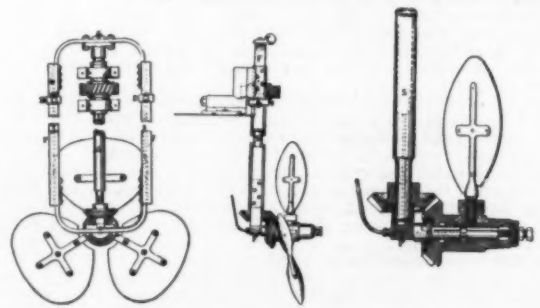


FIG. 3.—DETAILS OF THE SCREW AND ARRANGEMENT OF THE PROPELLER.

attract the leisure class. A beautiful sandy beach winds along the seashore, back of which rise lofty bluffs affording extended views seaward, the chain of islands which inclose Santa Barbara Channel on the west being clearly outlined against the sky. Hope Ranch had but one blemish. There was no permanent

water supply excepting that gathered during the brief rainy season of the winter months. Isolated from the interior by the precipitous coast range of mountains, there were no streams of sufficient permanence or volume to supply the 2,100 acres included in the ranch. With water for irrigation, Hope Ranch possessed every requirement for a semi-tropical paradise; without water it was little more than a barren waste.

The problem has recently been solved, and a supply permanent and sufficient for all purposes has been gained by boring into the sides of a mountain and tapping a plentiful reservoir there concealed.

Santa Ynez Mountain, which rises to a height of 4,000 feet, about five and one-half miles distant from the ranch, is distinguished as being the dominant peak of the neighboring range. It was noted that all of the little streams with permanent flow had their sources in this mountain. Geological investigation disclosed that Santa Ynez was composed of a stratum of shale 3,000 feet in width inclosed at either end by walls of hard, impervious sandstone several hundred feet in thickness. The flowing creeks had cut channels or cañons through the sandstone at elevations of from 1,900 to 2,200 feet above the sea. The project was entertained of boring a tunnel through the sandstone and into the vertical stratum of shale at an elevation of a thousand feet below the sources of the streams, with a reasonable certainty of striking an inexhaustible flow when the sandstone was pierced and the stratum of shale rock, saturated with moisture, attacked.

The project met with favor, and for a year past the work has been unremitted. Three months ago the shale was entered and water found. A total length of 500 feet into the shale has been driven and a daily flow of 2,721,600 gallons secured; more than enough for all purposes of the ranch and allowing a large surplus for irrigating outside lands, as well as affording a welcome addition to the supply of the municipality of Santa Barbara.

The tunnel itself is 1,377 feet above the sea. The water will be conducted through 7 and 8-inch pipes to reservoirs at Laguna Blanca, with a capacity for 200,000,000 gallons, situated 138 feet above tide, and also to another lake of less dimensions 398 feet in elevation.

BEHR'S MONO-RAILWAY.

This idea is gradually being brought into practical shape. In the early days of the proposed Manchester and Liverpool Behr Railway, a good deal was said about high speeds and safety when running round curves, as though all that was necessary to be done was to provide means to take up the centrifugal stresses due to the train only, says The Electrical Review. Passengers did not count, and we had to point out that if speeds of 100 miles per hour were run round curves of what we will term short radius, the passengers would hang like wet towels over the seat backs. Mr. Behr, in fact, like many other enthusiasts, has been too ready to assume all the virtues for the railway system he is pushing, and has been hiding his head in the sand in the hope that by so doing the sight of others would be similarly obscured. But doing this cannot annul the laws of mechanics, and in his recent paper on the subject which we have reprinted, we are glad to see that definite statements have taken the place of general platitudes. Thus we are told that a speed of 83 miles per hour was recorded round a curve of 540 yards radius, and we are now told that on the proposed line the minimum curve will have a radius of 750 yards. As regards speeds of 120 or 130 miles per hour we do not think much. They should be easy to attain on a sufficiently straight line. It is simply a question of power, and Mr. Behr can no doubt find out from electrical constructors how much power he must put into a car of 60 or 70 feet length to secure such speeds, how large or how many must be the motors to move such a car in 20 minutes between the two cities. On this subject Mr. Behr tells us nothing beyond that he will have a station of 7,500 horse power capacity. This is for a ten minutes' service, and there will be four trains running at one time, so that the motive power of each train is apparently calculated at nearly 2,000 horse power for one carriage only. We should like to hear more about the power and less about the brakes. The stopping of a train can be effected just as quickly as the sitting power of the passenger will allow, for it can be done by grip brakes. The only consideration is that the structure must be such that the grip brake employed shall not rip it up. In bridge work it is usual to calculate the braking effect of the train as regards its buckling effort on the chord on which the stress is resisted, and very careful calculations will need to be made in regard to the destruction of the stored energy of a car at 130 miles per hour when quickly brought to rest by a grip brake. Especially at points of curvature will this effect be apt to cause danger, for it is only on a straight line that the rails can resist as a strut. Thus, as regards both the safety of the proposed speed and the possibility of rapid retardation, we see no reason to doubt the system, but we should like to see figures of the power required and of the size and speed of the motors, the space they are going to occupy, and so on.

As regards retarding effort, it is stated that speed can be retarded at the rate of three miles per hour per second. Thus a train at 60 miles per hour should be stopped in 20 seconds, and one at 110 miles an hour in 37 seconds, during which time it will run 995 yards. This is with the Westinghouse brake, while with a magnetic brake acting on four grip rails, a train at 110 miles per hour should be stopped in emergency in 500 yards. Prof. Carus-Wilson, in the discussion on the paper, however, doubts the friction brakes being possible, because so much energy has to be dissipated. Would it not be possible to carry water to use on the friction brake at times of emergency? Lieut.-Col. Alan Cunningham pointed out the necessity for tilt round curves. We want to see the Behr railway at work, and are glad to see that the effect of centrifugal force is more fully recognized than it was even a year ago. High-speed running is fully as easy and smooth as low-speed work, and the whole question resolves itself into one of power and straightness. Those who know anything of the size of a 30 horse power tram-

car motor will naturally ask for information about the motors to absorb 2,000 horse power. Where are they to be placed? What is their speed and diameter, and do they really need to be of such a power as the central station estimate appears to indicate?

INDUCTION COILS AND INTERRUPTERS.

The rôle of the induction coil, which is a very interesting apparatus and readily lends itself to the performance of a number of amusing experiments, has become very important since the inception of researches upon the Roentgen rays and wireless telegraphy. As for interrupters, they have been the object of particular study, and many models have been devised that are giving satisfaction.

In the present article it is our purpose to describe

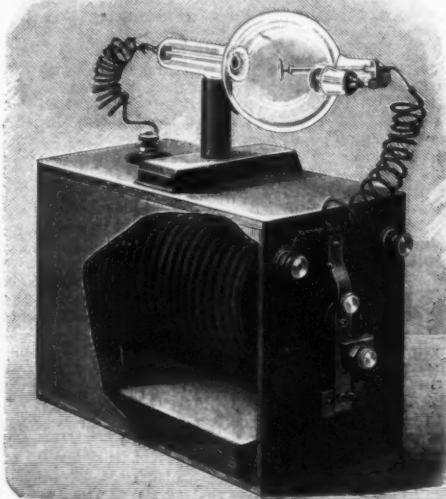


FIG. 1.—THE GUERRE INDUCTION COIL.

some new and simple forms of these apparatus that have given very good results.

Fig. 1 shows an induction coil of the Guerre type. Here the secondary coil is wound in sections on a series of flat disks 0.04 of an inch in thickness. The silk-covered wire, while being wound around these, is passed into a bath of insulating material. The disks are afterward mounted, one alongside of another, upon the primary of the coil and are connected in pairs and in tension. In his coils for X-rays, M. Guerre connects the extremity of the negative primary wire with the end of the secondary coil opposite the positive primary wire, grounding the two and also the negative pole of the battery. He thus obtains what he calls a "unipolar coil." This coil permits of producing a 3 or 4 inch spark that gives a good illumination of the bulb. In experiments in radiography and fluoroscopy sufficiently rapid interruptions are obtained by means of an ordinary vibrating interrupter controlled by a spring hook.

M. Guerre has, in addition, devised two new mercury interrupters for powerful induction coils and that are worthy of mention. The first of these (Fig. 2) is entirely separate from any coil. It consists of a bent strip of steel, A, that carries

accelerates or diminishes the vibrations. A plunger fixed to the ebonite cover of the cup permits of regulating the level of the mercury during the operation, and, consequently, the duration of the passage of the current.

These new arrangements are very ingenious, and permit of obtaining very interesting results in the study of Roentgen rays and Hertzian waves.—For the above particulars and the accompanying engravings we are indebted to La Nature.

HIGH-POTENTIAL PHENOMENA.*

By A. P. CARMEN.

In the earlier history of electricity there was nothing that excited the interest of the world more than the electric spark. It is hardly more than two centuries since the first electric spark was observed. We of this day have become so accustomed to startling discoveries that it is only with difficulty that we can understand the childlike amazement with which men in the eighteenth century heard of electric sparks an inch or so in length, and how the shock of crude little Leyden jars with their faint illumination was a matter for a year's wonderment and letter writing. The rapid development of galvanic or current electricity, the invention of the dynamo and of

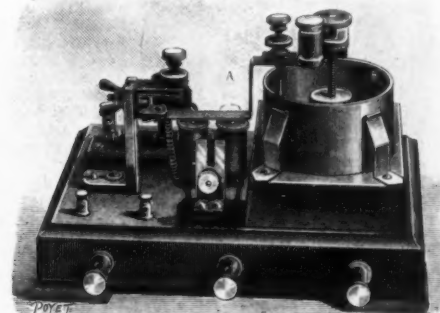


FIG. 2.—MERCURY INTERRUPTER.

the electric motor, and of alternating-current apparatus, and their extended use for lighting and power seemed to engross for years men's thoughts and activity, and high-potential or static electricity, with its less understood forces and more elusive phenomena, attracted less and less attention until a dozen years ago. There were so-called practical men who advocated writing our text-books on physics and electricity with static electricity relegated to an appendix. Only in the laboratory of the scientist was it regarded with much interest. All this is now changed. The disruptive discharge with its electrical spark has been found to be the center of a group of phenomena all-important in our understanding, not only of electricity and magnetism, but of light, radiant heat, and even of some fundamental properties of matter. And not only in pure science but in its industrial applications, the phenomena which center about and accompany the disruptive electric discharge are holding the interest of the electrical world. From the spark go out waves, traveling with the velocity of light, and these waves are the bearers of messages, giving us wireless telegraphy and wireless telephony. In connection with the oscillating static electric field, we get also some of the most beautiful illuminations

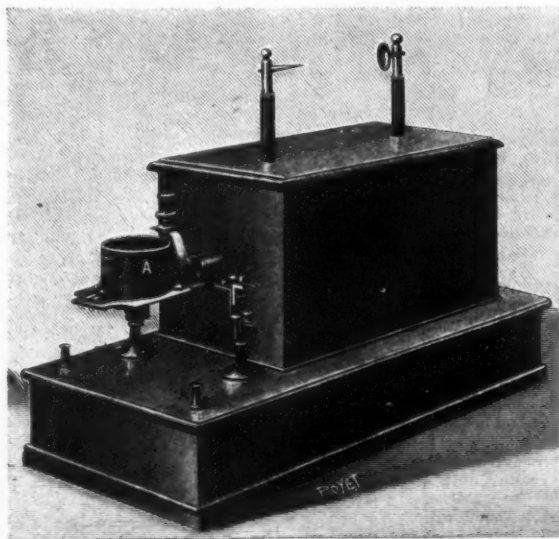


FIG. 3.—MERCURY INTERRUPTER.

at its extremity a small rod which enters an iron cup, B, containing a layer of mercury covered by a layer of petroleum. This strip is kept in constant vibration by means of an electro-magnet supplied by a local circuit of batteries. Another circuit is formed by the outgoing wire of the battery, the primary wire of the coil, the vibrating strip of steel and the mercury cup, which is itself connected with the other pole of the electric source.

The interrupter shown in Fig. 3 is still simpler than the one just described. It consists of a strip of steel bent and curved according to the contour of the soft iron of the coil and exceeding the latter by a few fractions of an inch. The rod placed at the extremity of this strip enters a receptacle, A, containing mercury and petroleum. A spring held by a set screw

of vacuum tubes. There are those who think that the electric light of the future is to be that from these electric discharges of high potential and of high frequencies in vacuum tubes.

Another circumstance that has forced these phenomena upon the attention of practical electricians is the introduction into commercial work of alternating currents of high potentials. It is only a few years ago since we were wrestling with the problem of handling a thousand volts. To-day, the use of 10,000 volts is not uncommon, while 20,000 and 30,000 volts are perfectly feasible, and even 100,000 volts have been considered possible. With such pressures

* Lecture delivered before the Illinois State Electric Association at the recent meeting in Champaign, Ill. Mr. Carmen is professor of physics in the University of Illinois.—Western Electrician.

the problems of electric discharge become the serious ones. At such potentials it becomes so very apparent that we are dealing with forces far beyond the little wires which we have formerly fancied carried the power. We propose this afternoon to review rapidly some of the fundamental phenomena of static-electric discharges and to show you one group of these phenomena, namely, that generally known as the Tesla experiments.

In this subject there is an advantage in starting with the very elements, so as to connect our ideas with familiar phenomena. I hope you will therefore pardon me if my account is very elementary for a few minutes.

Let us start with the well-known experiment of our school days—that of the fur and the vulcanite rod. We rub them together, and, upon separation, we find they are electrified or have charges of electricity. By this we usually mean that they have the property of attracting light objects, as pieces of paper, pith balls, or thin gold leaves. If we perform this experiment in a dark room we shall see still other phenomena, namely, a glow and even small sparks on the fur and along the rod where the two have been in contact. We get this glow and the sparks more pronounced when we electrify an insulated metal ball. This we can do by rubbing the electrified vulcanite along the metal body. The vulcanite rod thus communicates its electrification to the ball. When a body is thus electrified it has a tendency to give up its electricity to surrounding bodies. We describe this tendency by the term electric pressure or potential. We say the body tends to discharge itself because the electricity is at a pressure or potential higher than that of a neighboring body. Some substances offer very little resistance to this pressure. Thus, a piece of copper wire will allow an easy passage to the electricity from an electrified body. Such substances are called conductors. Other substances offer great resistance to the passage of the electricity. Rubber, glass and air are substances of this kind. They are called non-conductors or insulators. But the electric pressure or potential of a body may be made so great that it overcomes the resistance of the insulator and breaks through it. We then have the disruptive discharge. This may take the form of a spark, or it may be a phosphorescent glow or a brush discharge. In each case this is produced by the pressure or potential of the electrified body. We have the electricity constantly tending to flow from points of higher potential to points of lower potential.

How can we produce this high difference of electric pressure or potential, that is, a pressure capable of breaking through layers of air and giving disruptive discharges? We shall not try to mention all possible methods, but shall notice four, which are used frequently in the study of high-potential phenomena, and with which you are familiar from your papers and books. They are, first, static electrical machines, such as the Holtz and the Wimshurst machines; second, primary and secondary batteries; third, the ordinary induction coil or transformer; fourth, the Tesla high-frequency induction coil.

The static electrical machine is a piece of apparatus that cannot be said to have graduated yet from the physical laboratory, but since the discovery of the Roentgen or X-rays and the revived interest in electric-discharge phenomena, it has attracted more attention. We have several forms of the machine, as the Holtz, the Toepler and the Wimshurst machines, all of which are represented in the physical cabinet of the University of Illinois.

A description of these machines is not necessary here. It is sufficient to know that by revolving glass plates near similar fixed or moving plates we can get those plates highly electrified, and that, by certain devices, we can collect the electrification, so that a high difference of potential is produced between the discharge terminals of the machine. Static electrical machines are high-potential generators, but they give very small quantities of electricity; that is, the current is exceedingly small, but under very high pressure. To increase the quantity we use multiplate machines. Such machines do not have a higher potential, and hence do not give longer sparks, but they give us thicker and more continuous sparks; that is, they produce more quantity. We have been constructing here in the physical laboratory of the university a Wimshurst machine with twenty plates. Each plate is two feet in diameter, and it gives a heavy spark seven inches long [demonstrating].

The second method of producing an electrical pressure is by means of batteries. The terminals of an ordinary gravity cell are electrified. We have delicate instruments in the physical laboratory to show that they have the same kind of attraction as the terminals of the Holtz or the Wimshurst machine, but the pressures or potentials in this case are almost infinitesimal compared to that of the Holtz machine. Experiments made many years ago by Lord Kelvin show that it would take about 5,500 gravity cells joined in series; that is, so as to add their potentials to produce a spark one-twentieth of an inch long in air. The potential of a gravity cell is just a little more than a volt. This is our unit of electric pressure; that is, to produce a spark one-twentieth of an inch long in air requires 5,500 volts. To produce a spark of four inches requires probably over 125,000 volts, or as much as would be given by 125,000 gravity cells in series. But the current given by one gravity cell through a mile of telegraph wire is possibly greater than that given by this static machine. You can see that the galvanic cells are not well adapted to laboratories of limited means to the study of high potentials. Prof. Trowbridge, of Harvard, has a battery of 20,000 small storage cells, each giving him two volts, so that he can get a direct pressure of 40,000 volts; but that is the only case I know of where such very high potentials have been secured directly from a battery. We can, however, get high pressures from galvanic currents by the use of the induction coil. The induction coil consists of two separate coils of wire carefully insulated and fixed over a common iron core. A current, which is made and broken rapidly or is reversed rapidly, is sent through one coil and a difference of potential or electric pressure is by this means produced at the terminals of the other

coil. The first coil is called the primary coil and the other the secondary coil. The modern alternating-current transformer is, as you know, this induction coil adapted to commercial work. The induction coils which we have here are step-up transformers; that is, they enable us to take the low-pressure current of the primary coil and raise it to the high-pressure current of the secondary. This is accomplished by giving a proper ratio to the number of turns on the two coils. In this induction coil [indicating] we have about 14 volts' pressure in the primary circuit, and in the secondary we get 150,000 volts, possibly more, for it is hard to measure potentials that break across so many inches of air. I may say that the construction of a coil to give such pressure requires the greatest care. It means winding and insulating on the secondary coil of from 45 to 20 miles of wire of about the size of a hair.

There is another form of the induction coil which has attracted a great deal of attention. It is the famous Tesla coil, the form which Mr. Nikola Tesla used a few years ago in some brilliant public lectures which he gave before the electrical engineers of New York and of London. The Tesla coil is an induction coil with very high insulation and without any iron core. The Tesla coil which we have here [indicating] has the primary coil wound on a hard-rubber spool and this separated by several inches of air from a secondary coil which is wound on a glass tube. Often an oil insulation is used. Through the primary coil we send the high-potential discharge of our induction coil, or we can send the discharge of the Wimshurst machine. We thus have a high pressure in the primary and a still higher pressure in the secondary. But possibly the most important part in Tesla's coil is that we have a very fast interrupter in the primary, and so we get a very high frequency in our secondary. In the primary of the ordinary induction coil we have a vibrating interrupter which makes and breaks the current possibly 500 or 600 times a minute. Mr. Tesla introduces an interrupter which interrupts several million times a second. We introduce in the secondary of the first induction coil a Leyden jar across the ends, and then pass this discharge through the primary of our Tesla induction coil. Now the spark of a Leyden jar is oscillatory. That which looks like a single flash is, in fact, a series of oscillations back and forth of hundreds of thousands a second. The discharge of a Leyden jar is like the release of a spring. It vibrates backward and forward on each side of its final position of rest. The first man to show this fact was our own famous countryman, Joseph Henry. We take advantage of this oscillatory character of the Leyden jar discharge in the Tesla coil. The current induced in the secondary of a Tesla coil then differs from the current in an ordinary alternating-current circuit in two ways. First, it is at an enormously higher pressure, and, second, it oscillates so much more rapidly; that is, it has a higher frequency. In an alternating circuit we commonly have about 125 alternations a second. A Tesla coil will often have a million alternations a second, and Prof. Trowbridge, of Harvard, records one with 10,000,000 alternations a second. This high frequency plays a very important part in the phenomena that accompany the discharges from a Tesla coil.

We will now notice some of the phenomena of these currents. The first thing, and possibly the most striking to many of us, is that the wire terminals are all aglow. The electrification seems to leap from the wire at every point. In fact, it does escape in every direction. The excitation that we have here is not confined to the wire; in fact, in some cases it would rather go through the high resisting air than along the metal conductor. We have a loop of wire connecting the terminals of the coil and coming close together at one point, but still leaving a very considerable air gap. Now, to ordinary currents, the resistance of that air gap is thousands of times greater than that of the metal wire, but to these high-frequency currents the wire offers such a high resistance that the currents will jump across the air gap rather than go along the wire. This resistance of ordinary conductors of high-frequency currents is called impedance. Many of you are familiar with it in connection with lightning discharges. A lightning discharge is an oscillating current of high frequency; it will leap across air gaps rather than go around coils of wire. In our electric-lighting plants we make use of this fact by fixing convenient air gaps so as to protect our dynamos and other electrical apparatus. In the case of the current that we get from the Tesla coil the frequency is so high that the human body offers an enormous resistance, and these currents can be handled without injury, and that in spite of their high potential. The current glides over the skin without injury to the body. With ordinary frequency this amount of electricity would probably be fatal.

Striking as are these discharge effects in air at ordinary atmospheric pressures, they are still more striking and brilliant when they take place through tubes from which the air has been more or less perfectly exhausted. Take, for instance, a large glass tube connected to the air pump so that we can exhaust the air from it. It has two metal terminals, one entering at the upper end and one at the lower end, and we connect these to an ordinary induction coil. The discharge will not take place at ordinary atmospheric pressures, but as we exhaust the tube and the air becomes rarer the discharge begins to take place and streams of purple light are seen to come from the positive terminals. At a still higher rarefaction this purple light brightens into a beautiful reddish-purple spindle, and at higher exhaustions still the whole tube becomes aglow with a beautifully striated light. This is about as far as we can go with a mechanical air pump in our exhaustion. For higher vacua we use mercury air pumps and thus get those beautiful luminous effects that about thirty years ago Sir William Crookes discovered. Now these light effects are somehow connected with the rapid movement of the remanent electrified gas molecules—at least that is the way Crookes looked at it. In the tubes which Crookes used the discharge is between metal terminals or electrodes which are inserted through the glass walls of the tube.

A striking phenomenon in connection with these

high-frequency electric discharges which we get from a Tesla coil is that a vacuum tube need not have a terminal or electrode in order to be lighted up. Here [indicating] we have some highly exhausted tubes, a bulb and this long snake-shaped tube. They are simply glass tubes with no metal electrodes. We bring them into the region about this high-frequency discharge coil, and you see how they immediately light up. Somehow the remaining gas molecules have been set in motion, and we have this electric glow. You can see the same phenomena when we bring these tubes near the large Wimshurst machine. Perhaps this illumination is not very bright to you, but by taking tubes containing phosphorescent substances we can get a light which, if it is not as brilliant as our modern incandescent lamps, yet it may possibly compare with the tallow dips which our fathers had to use. Mr. Tesla sees in these tubes the possibility of the electric light of the future. We could have the ceilings of our rooms electrified, and then our lamps, these vacuum tubes, would light up anywhere in the room, electric lamps without wires. Indeed, we might go still further and make the walls of our rooms vacuum chambers, which would give a soft, diffused light similar to the light of day when an electric discharge was started in the room. But, even if this dream be never realized, and we still have to use our present fragile and low-economy electric lamps, this fact of the lighting up of these tubes in this whole region tells us something about electricity and electrical forces which is rightly regarded as one of the most brilliant and far-reaching discoveries in physics of the century.

It was the clear mind of Michael Faraday that first saw that electricity was something that extended away beyond conductors; but it was James Clerk Maxwell, one of the few geniuses of all time, who first grasped completely the grand conception that electricity is a movement and displacement in an ether which extends through all space and permeates all bodies. When a stone is dropped in a still pond you have seen how the waves go out in ever-widening circles, carrying the energy to the farthest shore. You know how the air vibrates from the pulsations of a tuning fork transmitting the sound energy. Thus the ether may transmit energy. The disturbance set up by the electric spark is transmitted out in waves through the ether, traveling with the velocity of light, for light itself is but an electric disturbance, a wave motion in this same ether. It is only a dozen years ago that this grand conception of Faraday and Maxwell was verified completely by Hertz. To-day we use the little electric sparks to send out electric waves, and Marconi has invented an instrument so sensitive that it is said he can detect these waves fifty miles and more from the spark that started them. It may be that you and I will see the power of Niagara transmitted to distant points by waves in the electric ether, as even now the energy of the sun is transmitted to us across space in this ether. This is the suggestion of one of our most practical electrical engineers, and who can say that this is a mere dream? Thus is the little electric spark which excited the wonder of the eighteenth century revealing to us things still more wonderful, and suggesting to us possibilities of nature far beyond our boldest dreams of a very few years ago.

NUT CRACKING BY ELECTRICITY.

An industry but little known, which has grown from small proportions in the last three years until now hundreds of thousands of dollars are invested in it, and it gives employment to several thousand persons, is that of cracking nuts for confectioners and fancy cake bakers. Three plants have been established in St. Louis. The output of the largest is some 1,500 tons annually, representing 125 carloads of nuts.

The work is done by machinery principally, electricity being the motive power. The process is slow, each nut having to be fed to the crusher by hand lengthwise. After the shell is cracked, the nut falls into a receptacle, from which it is taken and winnowed by an air blast. The meat is picked from the crushed shells by hand, women and girls being employed in this work.

The meats are assorted, wholes and pieces being sold separately. The latter go largely to confectioners, who use them in the manufacture of nut candy. The wholes go to fancy cake bakers for use in nut cakes.

Domestic nuts are the only kind broken here. They include the pecan, hickory, butternut, walnut and hazel nut. The foreign nuts are cracked before importation, a saving of 50 per cent in freightage being thus made.

The machinery employed in cracking nuts is expensive and covered by patents. It is closely watched to prevent any invasion of the rights of the inventor, and access to the workroom is jealously guarded.

When the kernel of the nut is extracted, it is placed in cold storage to prevent it from becoming rancid. The meat is so rich that when packed the oil is slowly but surely squeezed out of the kernel, rendering it unfit for market.

In addition to the machinery employed, large quantities of nuts are cracked by hand in a press-like arrangement worked with a lever. Here, too, only one nut is cracked at a time. The daily output of an electric machine is about seventy-five pounds. Five-eighths of the people employed in nut cracking are girls, their delicacy of touch being found well suited to the business.

St. Louis is the center of the distribution of the products of the Southwest, Texas, Tennessee, and Louisiana. Many million pounds of pecans are distributed through this market annually. The kernels are sold largely in the East, New York, Philadelphia, and Boston being heavy consumers.

The pecan is the principal nut used for the trade by the plants here, and most of the pecans are purchased in Texas. The Louisiana product is preferred by them because the shell is not so hard as that of the Texas nut, and consequently the work of extracting the kernel is comparatively easy.

There is no waste in the nut-cracking industry. Such of the meat as would be unfit for the trade for any reason is utilized, the oil being extracted and sold to manufacturing chemists. Even the hull is utilized, being used as fuel. The shells of the pecan, walnut, and hickory make a specially bright fire.

THE ORIENTATION OF GREEK TEMPLES.

A PAPER, "Some Additional Notes on the Orientation of Greek Temples," an abstract of which was read before the Royal Society on February 14, gave an account of six Grecian temples of which the orientation had been examined or re-examined during the spring of 1900. The chief observations and results described in the paper may be stated as follows:

(1) The grotto sacred to Apollo on Mt. Cynthus, in the Isle of Delos, was interesting as being not improbably the very earliest existing structure of a religious character on Greek soil. The orientation seems, as usual, to have been connected with the zodiacal star, α Librae, and the date of the formation of the grotto derived from this is about 1530 B.C. The original foundations of temples in Greece on some other sites are, indeed, more ancient than this; but it is presumed, and in a good many cases can be clearly established, that in those cases what can be now seen and measured is that which remains of reconstructions following the same lines as the earlier works. But this grotto at Delos, the sides of which are formed by the natural rock, and the roof and doorway only are artificial, is probably the very shrine alluded to by Virgil as already ancient at the time of the Trojan war (*Templa dei saxo veneranda structa vetusto*, *AEn.* iii. 84).

(2) At Delphi, where the clearance of the site by the French archaeologists gave a better opportunity of examining the celebrated temple of Apollo, there is evidence of a change of orientation, one, evidently the more ancient, having the angle $231^{\circ} 18'$, the other $227^{\circ} 8'$. These are the angles of the axis when looking east, measured from the south point by west. The site is very peculiar, being surrounded by mountains. The sun must have illuminated the sanctuary through an opening on the flank, as was the case at Bassae, also dedicated to Apollo; and there are only two dips between the mountains where the sunrise could have properly represented the early dawn. One of these has for amplitude $-7^{\circ} 42'$ E., the other $-23^{\circ} 16'$ E. The latter, taken with the earlier orientation, and the bright star ϵ Canis Majoris setting near the western axis, where local horizon is favorable, suggests 950 B.C. as the date of the foundation. The sunrise at the $7^{\circ} 42'$ point, and the sufficiently bright star β Lupi, setting also near the western axis of the more recent temple, offers the date of 580 B.C., but this would have been the predecessor of the structure which now occupies the site. It is known that the temple must have been several times rebuilt, and many stones of a previous temple, or temples, are found in the existing foundations.

At Syracuse it was found necessary to reconsider the orientation date (given in a former paper published in 1897) of the temple which has been attributed to Diana, but which is now known from an inscription to have been dedicated to Apollo. Of this temple, both the style of the architecture and the shape of the letters of the inscription above mentioned show that the date 450 B.C. given in the paper referred to, the orientation having been derived from the axis, is too late; and that the alternative date, derived from the northern limit of the eastern opening, which in this case can be obtained with accuracy, should be taken instead. The date, so altered, becomes 700 B.C., which is thirty-four years subsequent to the Hellenic foundation of the city.

N.B.—In Greek temples the question whether the sunrise entered upon the line of the axis or on the northern limit of the eastern opening has generally to be taken into consideration and decided upon archaeological grounds. This results, in the majority of cases, in favor of the axis; but in an important minority—notably at Athens—the other has to be chosen.

(3) In the paper an argument is drawn from the orientation of the foundations of a small temple lately discovered, adjoining the famous theater at Taormina, that the theater itself was that of the early and populous city of Naxos, which occupied the sea-coast at about 800 feet immediately below it; and not the work of the much later town of Taurominium, from which Taormina derives its name. Naxos was utterly destroyed by the Syracusans about 400 B.C.

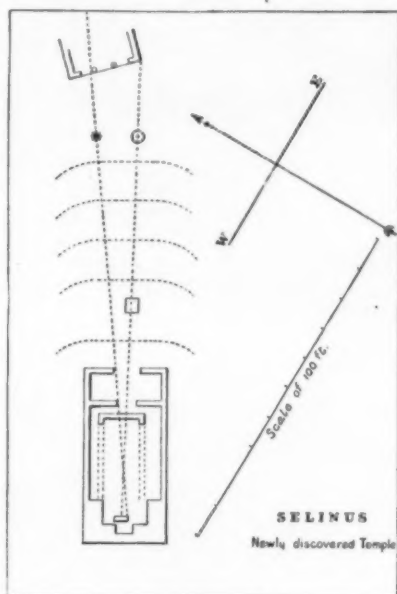
(4) The most interesting example, however, is from another Sicilian temple lately unearthed at Selinus. Of this temple I found the orientation of the eastern axis to be $30^{\circ} 22'$ north amplitude, which at once suggests a solar temple arranged for the summer solstice, which for a level site and for the date in question should be $30^{\circ} 35'$. But the temple's site is near the bottom of a valley; and the sun would have to gain an altitude of rather more than two and a half degrees before it could shine into the temple, and then the amplitude required would be $28^{\circ} 17'$. Thus, apart from what may be derived from the plan of the temple itself, the orientation theory would seem to show to a disadvantage.

The plan of the temple, however, appears to give the solution of the difficulty. It will be seen on examination of the accompanying figure that about 130 feet distant from the sanctuary there was a portico, i.e., the propylaea or entrance to the temple inclosure. One of two dotted straight lines drawn from this portico, namely, that which proceeds from its S.W. corner, indicates the direction of the first beam of sunrise as it rose at the summer solstice over the local horizon, about the middle of the sixth century B.C.; but it will be seen that while it passes centrally through the doorway it falls obliquely and eccentrically upon the western internal wall of the temple, the amplitude of this line being $+28^{\circ} 17'$ E.; but it will be also observed that it does fall centrally upon the western internal wall of a *naos* constructed within the flank walls of the temple. The square object which the line intersects before it reaches the temple is an altar, itself of no great height, and on lower ground, and which therefore interposed no obstruction to the solar rays reaching the sanctuary. The difference of level between the floor of the temple and that of the propylaea is about 18 feet. The warning star β Gemorum, which would have been heliacal—that is, just visible before extinction—about an hour before sunrise, and the direction of which is represented by the other straight dotted line, would have been well seen over the roof of the propylaea, the height of which, as known from architectural fragments, would

not have exceeded 23 feet, and the star would have overtopped this by about 2° .

The explanation, by help of the plan, of the apparent misfit of the orientation is as follows:

Presumably the angle upon which the lines of the temple were set out was taken from data obtained on some platform which had a level horizon, and the building was considerably advanced before the actual



solstice came round and showed the error that had been made.

To meet the difficulty, a *naos* was constructed within the flank walls, but hugging the northern one; so that the first beam of sunrise coming through the center of the eastern aperture, at the local amplitude of $+28^{\circ} 17'$ E., might shine in centrally upon the statue of the deity; and for this a pedestal was provided a little northward of the center of the niche which had been previously formed for it. We may notice also that the southwest angle of the propylaea is so placed as to keep exactly clear of the point of sunrise.—F. C. Penrose, in Nature.

MINING ANCIENT RIVER CHANNELS IN CALIFORNIA.

By ENOS BROWN.

IN California, at the present time, special attention is being paid to mining the channels of "dead rivers," as they are known in miners' phraseology, which constitute one of the most remarkable features of the complex geological system of the State. These rivers are supposed to be a heritage of the Tertiary age, when streams of water exceeding many times the volume of the largest river on earth flowed along the slopes of the Sierra Nevada, denuding the mountains of soil and gravel and crushing from the ledges which resisted their currents vast quantities of argenteous quartz and, by attrition, releasing the gold which, falling to the bedrock of these mighty streams, has there remained, a treasure concealed, to be discovered ages after these rivers had ceased to flow.

The aggregate length of these ancient channels in California alone is over four hundred miles. Their dimensions frequently exceeded two miles in width with a depth of from five hundred to fifteen hundred feet. Generally, they flowed from north to south, at right angles to the rivers which now flow west. All of the modern streams have forced their way through the deposits which once filled the channels of the ancient rivers; and a very large proportion of gold rescued from the placers by California miners, if not by far the larger part, is believed to have been first deposited in the currents of rivers of the Pliocene age. They offer a complete puzzle to the learned geologists of the present day, for in every instance the channels of the ancient rivers were from 1,500 to 6,000 feet above the Sacramento River as it now runs, a fact also which appears to support the theory of a great lake which once covered the productive valleys of the Sacramento and San Joaquin, with an outlet at the Golden Gate, which, by some great convulsion, was destroyed, causing the lake to shrink to the present dimensions of San Francisco Bay. Many of these ancient channels formed outlets for lava flows from northern volcanoes, burying the gold-bearing gravel to depths of 150 to 600 feet. One of the best known of these mines shows a volcanic cement capping of 150 feet in depth, cemented white siliceous sediment of 40 feet, and underneath angular gravel quartzose containing the gold, all above the bedrock of State.

The ancient river channels have been traced from the northern boundary of the State as far south as Mariposa County. The Blue Gravel channel starts at an altitude of 4,700 feet at the north line of Sierra County and flows south for 65 miles. Tuolumne Table Mountain and Butte Table Mountain, flowing for 40 miles in a channel one-half mile in width, are ancient river beds. Where the Tuolumne River has forced its way through these barriers majestic cañons, 1,500 feet in depth, have been formed.

The restrictions upon hydraulic mining in California and its practical suppression for twenty years have given great impetus to channel mining. In all of the eastern counties of the State from Tuolumne County north, expensive plants are in operation or projected for opening up the ancient deposits. Where a value of from \$1 to \$3 a ton is assured, the deposit can be profitably worked.

The famous Sweepstake mine of Trinity County is one of the later discoveries of mines of this character.

Its dimensions are: Length, 4 miles; average width, 2,000 feet, and depth of channel, 500 feet. It has an elevation of 1,800 feet above Trinity River. A great deal of development work has been done at an expense of several hundred thousand dollars. Two large openings from north and south have been driven preparatory to the completion of a ditch and siphon by which water may be brought to the mine. This involves work of a high engineering capacity. The ditch from Canyon Creek is of a capacity to flow 4,000 miners' inches a minute and is 29 miles in length. For crossing an intercepting valley 920 feet in vertical depth a siphon is being constructed of steel pipe 36 inches in diameter, 10,000 feet in length, and will be the most remarkable work of the kind in California. Upon this improvement the proprietors will expend \$450,000. The gold recovered in prospecting work is remarkably pure, averaging 950 fine and worth \$19.25 an ounce. The flakes are of the form known as "melon seed," and are iron-stained and in size from grains to a quarter of an inch in diameter. With the ditch working to its full capacity 15,000 cubic yards of gravel will be removed each day.

THE MINING STATISTICS OF THE WORLD.

IT is impossible to imagine a more concise, more intelligible, or more inexpensive collection of comparative mineral statistics than is contained in the General Report on Mines and Quarries prepared by Dr. C. Le Neve Foster for the Home Office, and it would be difficult to find an editor possessing in a more marked degree the requisite technical knowledge, literary skill and critical acumen for the difficult task of abstracting and collecting official mineral statistics of foreign countries and of rendering them intelligible to the general reader. In many countries the statistics published are imperfect or antiquated. Nevertheless, as regards output, Dr. Le Neve Foster has succeeded in getting together a mass of figures which, in the case of the more important minerals, may certainly be regarded as trustworthy. He has brought into one focus a representation of the present position of the mining industries of the world, and has thus rendered it possible to comprehend the enormous development that has taken place within recent years. The statistics given are of the greatest importance from a commercial point of view. In the United Kingdom alone the value of the minerals raised in 1899 was £297,470,000, and the vast sums representing British capital invested in mines in all parts of the world will be readily appreciated. Some indication of the remarkable strides made by the mining industry during the past ten years is afforded by the following comparison of the world's output of metals in 1889 and in 1899:

	1889. Metric Tons.	1899. Metric Tons.
Iron	26,000,000	39,136,000
Gold	182	477
Silver	3,900	5,445
Copper	266,000	507,000
Lead	549,000	676,000
Zinc	335,000	511,000
Tin	55,000	74,000

In 1899 the world produced 723,239,000 tons of coal, 16,755,000 tons of petroleum, and 12,890,000 tons of salt. Nearly one-third of the coal supply was furnished by the British Empire. The United States supplied nearly another third, and Germany more than a sixth. The remainder was contributed mainly by Austria-Hungary, France and Belgium. The coal production of the principal countries was as follows:

	Metric tons.
United States.....	230,524,000
United Kingdom.....	223,627,000
German Empire.....	135,824,000
Austria-Hungary.....	37,562,000
France	31,218,000
Belgium	22,072,000
Japan	6,761,000
India	5,016,000
New South Wales.....	4,671,000
Canada	4,142,000
Spain	2,671,000
Transvaal	1,938,000

In 1889 the United States for the first time outstripped Great Britain as a coal-producing country. In twelve months the British increase was 18,000,000 tons, but that of the United States was 30,000,000 tons. This enormous increase is undoubtedly due to the extended use of coal-cutting machinery. In the United States 23 per cent of the total output of coal was mined by machinery. Only a little more than 1½ per cent of the output was so obtained in Great Britain. The path of progress is, therefore, clearly indicated to British colliery owners.

As gold producers the British possessions take the first place, and, thanks to the increased output of Canada and of Western Australia, the British Empire reached a total of 5,475,000 ounces, or more than one-third of the world's supply. One-fourth of the world's salt, and more than half of the tin, are produced by the British Empire. On the other hand, the production of copper, lead, petroleum, silver and zinc is small in comparison with the world's output. The magnitude of the petroleum industry is surprising in view of the fact that its growth has been within the last half of the nineteenth century. The chief producing countries were: Russia with 8,340,000 tons, the United States with 7,247,000 tons, Austria-Hungary with 325,000 tons, Roumania with 318,000 tons, and the Dutch East Indies with 217,000 tons. The United States has had to cede to Russia the position it so long held as first in the production of petroleum.

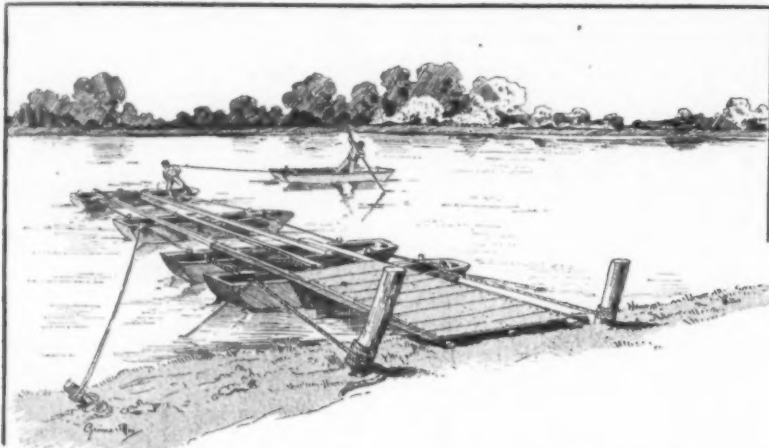
In 1899 the Transvaal was the greatest gold-producing country of the world, the output representing a value of £16,273,000. Owing to the war, detailed statistics for 1899 are not available. In Cape Colony the outbreak of the war in October caused a rapid decrease in the output of the coal mines, and eventually stopped nearly all of them. In Natal, again, coal mining was interfered with, and no official report for 1899 has been received. In Rhodesia, on the other hand, gold mining made remarkable progress. The output of gold was 65,304 ounces in 1899, while in the previous year it was 18,085 ounces. The mining pros-

pects of the country are certainly very satisfactory, more especially as the search for coal is giving most promising results.

The copious references to original sources of information given by the editor in foot-notes form a very valuable feature of the report. In this connection it

1899 throughout the world amounted to 4,312,000, of which 1,635,000 were engaged in the British Empire. The United Kingdom headed the list with 862,000 persons. Then followed Germany with 527,000, the United States with 488,000, France with 302,000, Russia with 239,000, Austria-Hungary with 219,000, Belgium with

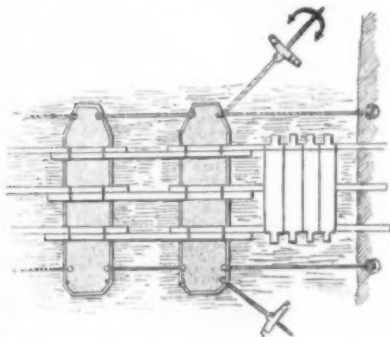
mining industry of Ceylon, which is comparatively insignificant as regards output, should afford occupation to as many persons as are employed in mining in all the other countries of the British Empire put together. Such figures are utterly useless for calculating death rates, and have, consequently, been discarded. The standard adopted for death rates is the number of persons killed per 1,000 employed, and a comparison of the figures in different countries affords a good idea of the relative safety of the miner's occupation. In Great Britain, in 1899, there were killed in coal mines 1.24, in other mines, 1.76, in quarries 1.19, and in all mines and quarries 1.26 per 1,000 employed. For the British Empire the average was 1.27 for coal mines and 1.64 for metal mines, and for the world 1.83 for coal mines and 1.64 for gold mines. In foreign countries the average was 2.25 in coal mines. It is evident, therefore, mining is conducted in Great Britain with a far smaller risk of accident to the workers than in most other countries. This gratifying result is due in no small measure to the untiring efforts made to improve the conditions of mining by means of legislation and government inspection.—Bennett H. Brough.



CONSTRUCTION OF A BRIDGE OF BOATS.

is noticeable that in his capacity of juror at the Paris Exhibition Dr. Le Neve Foster has had access to numerous special reports which, but for his assiduity, would hardly have come to the knowledge of English engineers. The great development of the iron ore resources of Luxemburg during the last thirty-two years, for example, was clearly illustrated in a table shown in the Paris Exhibition. In 1868 the output of iron ore was 691,000 tons, while in 1899 it was 5,995,000 tons. At another place in the volume the latter figure is given as 6,014,000 tons, there being apparently a slight discrepancy between the figures obtained by the Home Department of the Grand Duchy and by the German Customs Union, of which Luxemburg forms part. The political classification of the various States is in several cases a matter of difficulty, and has been attended to by Dr. Le Neve Foster with scrupulous care.

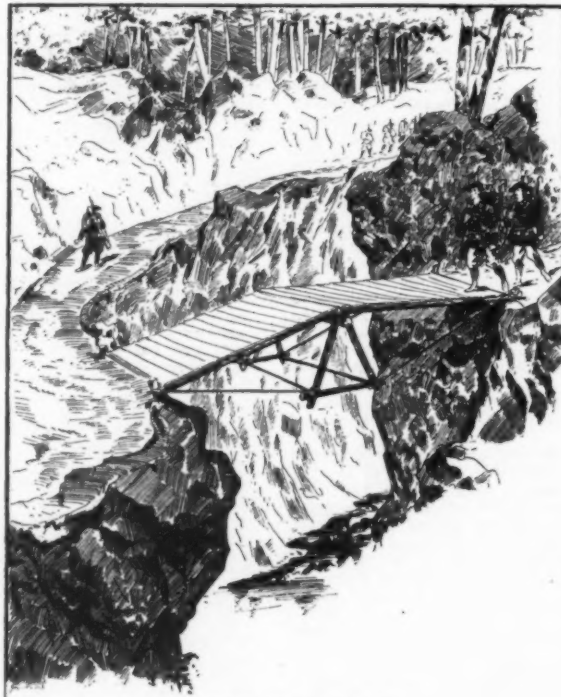
164,000, and Japan with 133,000. Prior to the war the late South African Republic employed 100,000 miners. It appears that the British Empire employs more than one-third of all the persons engaged in mining and quarrying in the world. It must, however, not be



ELEMENTS OF A BRIDGE OF BOATS.

It is possible, however, that in dealing with Austria and Hungary under one heading, while Sweden and Norway are dealt with separately, he will cause offense to the ultra-patriotic Magyars. Since the compromises between the two States, renewable every ten years, was not renewed in 1897, the Union is merely personal through the Emperor and Apostolic King, and in order to make it evident that Hungary is not a vassal State, the official denomination of the Austro-Hungarian monarchy is to be preferred to the term Austro-Hungarian Empire used in the report.

Although not so trustworthy as the figures relating to mineral output, the statistics of persons employed and of accidents in mines are quite as important. The number of persons employed at mineral workings in



MOUNTAIN BRIDGE.

forgotten that published figures are far from being absolutely accurate, and those cited by Dr. Le Neve Foster are merely the best obtainable at the present time. As an example of inaccuracy, the official returns from Ceylon give 1,108,306 persons employed in 1898 in mining in that island. It is incredible that the

inexperienced men. It takes the pontoniers but three minutes to form one span and but an hour to construct a bridge over three hundred feet in length. If the bridge is begun at both shores simultaneously it may be finished still more rapidly. This method, however, becomes difficult and dangerous when the enemy is occupying the opposite shore.

Sometimes the boats are joined in twos and threes, and thus constitute what is called a "portiere." The portieres are placed in position as in the preceding method, with a space of about twenty feet between them.

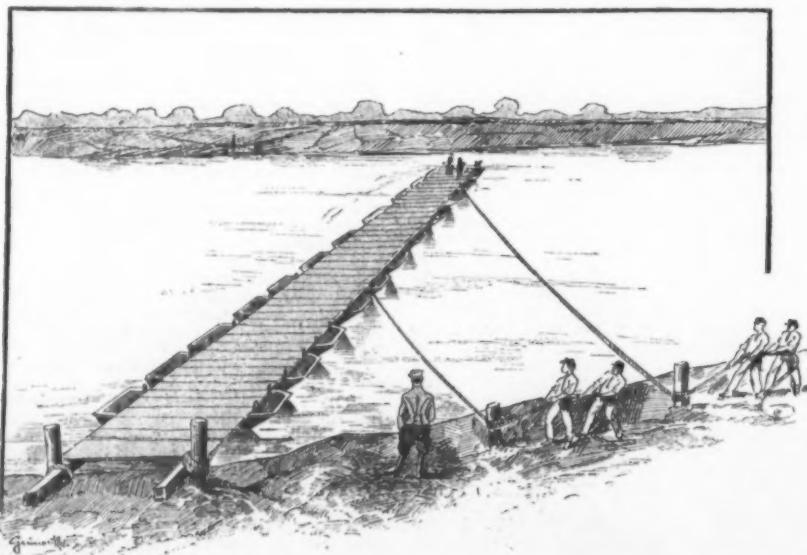
Sometimes the entire bridge is constructed along the shore above the point where the river is to be crossed. In this case the head of the bridge is firmly secured to a stake driven into the ground of the shore, and the other extremity is pushed by the current, which swings the bridge around in its entirety until the last boat stops near the opposite shore. If the bridge has been well constructed its extremity should come within a few feet of the shore. A floor is then laid between the latter and the boat, all the bands are tightened up so as to assure rigidity, and the bridge is finished.

This method permits of putting the bridge in place in a few minutes; but it is rather a delicate one to employ, especially if the current is swift, and requires an experienced corps of pontoniers. The swinging motion has to be retarded by means of ropes held on the shore and that are strongly anchored after the bridge has been completed, so as to prevent it from being distorted or carried away by the current.

This method may be profitably employed when the enemy is occupying the opposite shore.

Bridges of boats permit of crossing almost all water-courses and are capable of giving passage to all armies.

When, through force of circumstances, it is impossible to construct bridges of boats, recourse is had to trestle bridges. These are easy to establish in water-courses of a maximum depth of 11.5 feet, and the current of which does not exceed from 5 to 6.5 feet per second.



SWINGING A BRIDGE OF BOATS INTO POSITION.

The construction of a trestle bridge is, in principle, a very easy thing. The trestles are placed here and there across the watercourse at the point at which the bridge is to be located, and are then connected by planks that form a floor. The spacing of the trestles depends upon the length of the planks that are at hand and

these are jointed so that they can be lengthened or shortened at will; and it is also possible to vary their inclination. Finally, they can be placed vertically at once, and are capable of adapting themselves to all the changes of level of the river bed.

Bridges of boats or of trestles, when well con-

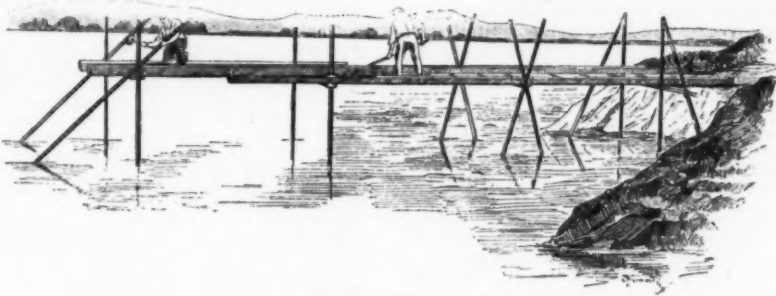
structed, are always sufficient to allow infantry and cavalry to cross the majority of watercourses; but when it is a question of re-establishing a railway bridge, in order that it may support the enormous load of a train, must necessarily possess a still greater solidity.

In such cases there are employed iron or steel bridges composed of dismountable pieces that are assembled in sections. There are various types of these.

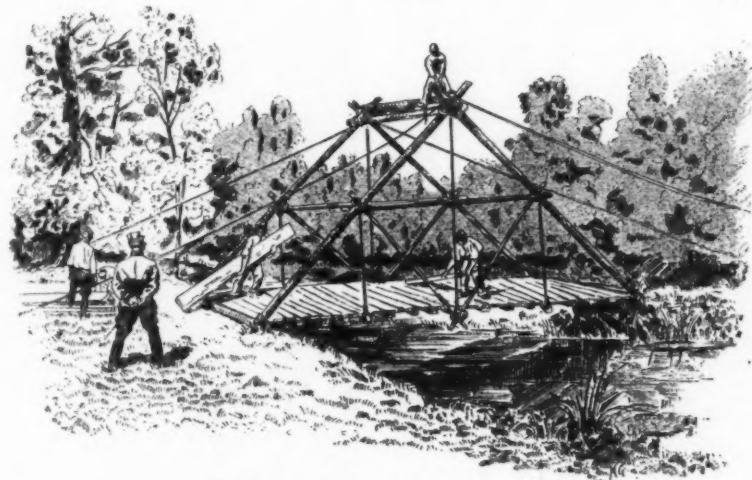
Numerous experiments in the construction of bridges in recent years by inexperienced men and with materials found upon the shores have shown that the establishing of a footbridge or an improvised raft for crossing a river of medium width, the current of which is not too swift, is an operation much easier than might be supposed.

Excellent footbridges may be constructed of the most rudimentary materials, such as casks, ladders, boards, poles, window shutters, and, in a word, all materials capable of floating. Bridges are also established with distributing bags or nosebags of impermeable cloth filled with straw or other light material and tied tightly at the neck. When these are put into the water they perfectly fulfill the part of casks. Each is capable of supporting a load of 110 pounds. These bags are placed in conjunction and parallel with the current. Then a ladder is fastened to them and upon this are laid planks to form a floor.

Capt. Habert's bag-rafts are based upon the same principle. The bag, which weighs from eight to eleven pounds, according to the type, is carried rolled up under the saddle or slung across the shoulder. It is provided with rings around its circumference to permit of assembling several together. It is stuffed with light



PFUND BRIDGE.



FRAME BRIDGE MADE OF POLES.

upon the load that they have to support. In order to put them in place several methods are employed. The most common of these consists in the use of string pieces. Two string pieces or bulks from 25 to 30 feet in length are arranged on each side of the axis of the bridge upon the part of the floor that has already been laid, and rest upon rollers. The trestle is placed upon their outer extremity, and the pontonniers, maneuvering by the shore end, push them forward and thus carry the trestle to the distance desired. The trestle is then let down into the water and installed in a proper position by raising the tail end of the bulks. Bulks are then placed upon the cap piece of the last two trestles, and upon these the floor is laid. On a campaign they are most rapidly put in place by allowing the men to work in the water.

The establishment of a trestle bridge requires that the transverse profile of the watercourse shall first be obtained by soundings, and then the trestles must be constructed according to measure. It often happens that the latter do not possess sufficient perpendicularity to the bed of the river, which may present changes of level; and then, too, if during the passage the bottom is unequally resistant, the legs will sink into it to various depths and produce distortions of the floor that may put the bridge out of service.

The use of the Birago trestle remedies such inconveniences in part. This consists of a cap piece provided at its extremities with two inclined mortises through which the legs are shoved until they rest upon the bottom. Suspension chains secured to the top of the legs unite them with the cap piece. This arrangement permits of sinking the trestle to different depths and of giving it a proper foundation. The stability of the legs is further increased by the use of sills. In order to maintain the stability of the bridge longitudinally the bulks that receive the flooring are provided with claws that prevent these supports from turning over. This trestle presents to the current nothing but a narrow leg in the transverse direction, but it possesses the inconvenience of having no stability by itself and of requiring the use of bulks with claws.

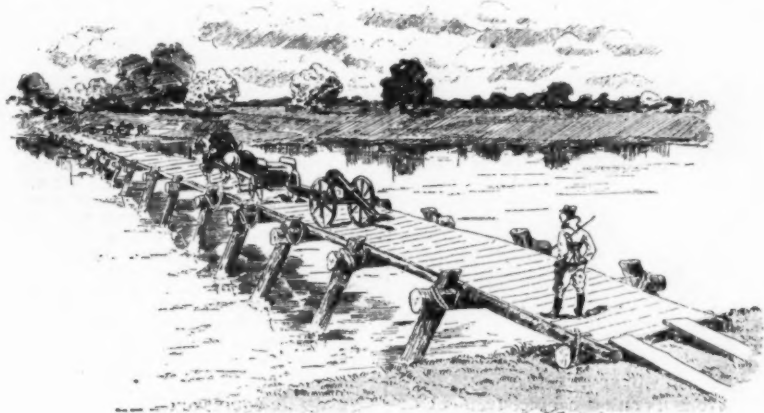
A M. Pfund has recently improved such bridges by constructing hollow steel trestles, which are very light and, consequently, easily transportable. The legs of

As each army corps possesses but one bridge equipment the number of the latter is quite inadequate to answer the exigencies of modern warfare. An endeavor has therefore been made to find a means of permitting troops to cross watercourses by improvising the necessary rafts and footbridges, without having recourse to the army corps equipments, which are more especially reserved for the artillery.

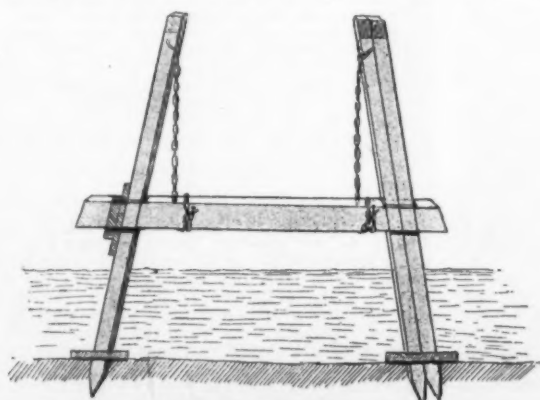
materials, such as reeds, leaves, etc. The raft is capable of carrying five or six men, according to the type. Its stability is increased by coupling two bags. These same rafts tripled are capable of transporting an empty army wagon, while four of them juxtaposed will carry a loaded wagon or a gun.

Capt. Netter has devised a very light portable foot-

bridge which has been employed in Tonkin. It is



BRIDGE OF TRESTLES.



BIRAGO TRESTLE.



ESTABLISHMENT OF A BRIDGE OF TRESTLES.

made of bamboos split in four and serving to form the weft of a sort of fabric analogous to certain window curtains that can be rolled up from one side only. The warp is formed of twenty wires. It is a genuine cloth 3.28 feet in width and 33 in length, forming one element of a bridge. Three of these elements united give the bridge a span of 99 feet. Each element weighs 66 pounds and may be rolled up for transportation. Such a bridge, which may be quickly put in place, supports a weight of 1,100 pounds.

Finally the ingenuity of army officers is daily discovering new arrangements, such, for example, as the mountain bridge illustrated in one of our engravings.—*Le Monde Moderne.*

THE EUROPEAN AND ASIATIC FAUNAS, AND THEIR RELATIONS PAST AND PRESENT WITH THAT OF AFRICA.*

In dealing with the European and Asiatic faunas, and their relations past and present with that of Africa, we have to do with three strongly diverse zoological regions: First, the Palearctic, which comprises all Europe, and Asia north of the Himalayas; the Ethiopian, comprising Africa south of the Sahara; and the Oriental, taking in Southern Asia and the East Indian Archipelago.

On the map it will be seen that an almost continuous chain of islands runs from the mainland of South-eastern Asia to Australia. At the extremes of the chain two widely diverse faunas are found. Thus the land mammals of Australia are of the lowest groups—marsupials, such as the kangaroo, and monotremes, the duck-bill mole; while there are only a few mice and a single carnivore, the dingo or native dog of Australia, to represent the higher mammals. In the Oriental region, on the other hand, we have no marsupials, but a highly diversified fauna of swine, deer, elephants, apes, squirrels, etc. There are also decided differences in the birds; although the Australian birds are not as a whole low types, as in the case with mammals. Among the lower animals Australia has a strong infusion of the Antarctic fauna. The fresh-water fishes, the earth-worms and many groups of mollusks are common to Australia, New Zealand and Southern South America. This Antarctic element of the Australian fauna is wanting in the Oriental region. As we go northward from Australia along the islands the peculiarly Australian forms of life rather abruptly disappear and we come to the islands where the Oriental elements predominate.

Some thirty years ago Alfred Russell Wallace, who may be considered the founder of zoogeography, or the science of the geography of animals, mapped out the boundary between the Australian and the Oriental regions, running between the islands of Bali and Lombok, east of Java. The two islands are only about twenty miles apart. Further to the east, he ran the line between Celebes and Borneo. All the islands north of this line were considered by Wallace to have Oriental faunas, and south of it, Australian; and although the line ran between islands in some cases only about twenty miles apart, it was thought to separate two faunas of widely diverse origin and history. This line, the position of which is worth remembering, is called "Wallace's line."

Wallace's line was founded mainly upon the distribution of mammals and birds; and it answers also equally well for some other animals. Thus the fresh-water fishes seem to be bounded by this line; the carp family of fresh-water fishes go south in the East Indies as far as Wallace's line, while they do not extend into the Australian region where the fresh-water fishes are of Antarctic types. On the other hand, the snakes do not agree with this line. A good many genera of snakes are distributed right across the line, with very little apparent reference to it; and this is also the case with the land snails. Thus, one genus of land snails, Amphidrom, ranges from southeastern Asia through Sumatra, Borneo and Java across into Celebes; and eastward from Java they run into Bali and Lombok, Sumatra and Timor, and as far as the Tenimber Islands, which are quite near New Guinea; so that in case Wallace's line is entirely non-existent for these animals, their distribution evidently has been regulated by other means than that which checked the distribution of mammals. Many other land snails have the same distribution. There are among the other invertebrates numerous groups of which the species are distributed right across Wallace's line.

Now it is evident that, where we have a great many groups of land animals which have no means of crossing any considerable extent of sea and are distributed throughout an archipelago as they are in the East Indies, the explanation of their distribution given by Wallace and others is the only tenable one; that is, that the land formerly stood at a higher level and all these islands were united by dry land, giving opportunity for the spread throughout the group of all these various land animals. This is the easier to believe, as the hundred-fathom line takes in all of the islands with which we have to deal here, except possibly some of the Philippines. But from the fact that a great many of the lower animals extend right across Wallace's line, it is obvious that there has also been land-connection beyond Wallace's line. Invertebrate animals change very much more slowly than vertebrates; we find genera of invertebrate fossils running backward further in geologic history than the back-boned animals. The invertebrate groups have existed longer, so that the groups which extend across Wallace's line are older groups than those which simply extend to it; and the theory may be reasonably held that in the Mesozoic age dry land extended from southeastern Asia all the way to Australia; and that over this dry land the various animals which were then in existence were distributed and spread as far as Australia. The low mammals which existed in the Cretaceous period in the northern continents had at that time opportunity to spread south to Australia; and at the end of the Cretaceous, or probably very early in the Eocene, the connection was broken by the depression of a belt through the East

Indies somewhere in the neighborhood of Wallace's line; and the new types which came into existence with the Tertiary had no opportunity to spread south of that depression. The higher animals therefore, such as deer, tapirs, cats, apes, which did not become developed in their present form until late geological time, simply spread as far as land extended and for that reason did not get below Wallace's line.

On the long peninsula which was left when the depression took place separating off the Australian region, a rich and abundant fauna developed. Probably the first part to be cut off from this mainland was the Philippine Archipelago. Here we find fewer mammals than in Borneo or more western islands of the archipelago, as well as some peculiar groups of snails not found elsewhere; such as *Helicostyla*, brilliant-colored land-snails living in the tree-tops and very numerous throughout the Philippine Islands.

The western part of the Oriental region has close relationships with Africa which have been the subject of a great deal of discussion by both zoologists and geologists. These relations are of various kinds. Thus the great cats and the antelopes are found in Africa, Arabia and extending into southern India; and there are also relations between the faunas of Madagascar and the Mascarene Islands, and Ceylon and adjacent portions of India. We have in Madagascar the group of lemurs, "Half-apes" (half-apes) as the Germans call them, developed in a great variety of species; there are also lemurs in Ceylon and in the East Indies. A good many years ago, Scialer, an eminent British ornithologist, proposed the hypothesis of a former land lying in the northern part of the Indian Ocean and connecting these now isolated bodies of land—Madagascar, Ceylon and the East Indies. This great continent as it would be he proposed to call "Lemuria," from the fact that he founded it primarily upon the distribution of lemurs, and he supposed that it was upon this continent that they had been developed. This hypothetical continent was taken up by the distinguished German scientist Ernst Haeckel, of Jena; and in his "History of Creation" Haeckel claimed Lemuria as the birthplace of the human race. One of the plates in that highly theoretic work shows the lines of migration from Lemuria of man into the adjacent continents.

Haeckel's brilliance and wide knowledge attracted a good deal of attention to the hypothesis of Lemuria for a time; and there was, of course, something to be said in favor of his view, because we have the existing anthropoid apes, such as the gorilla in Africa and the chimpanzee and the orang in Borneo and the East, on both sides of this supposed continent; so that there would be no more natural place for man to have had his rise than in the midst, between these scattered members of the group of anthropoid apes. But it was soon realized that if any such land as this had existed within the human period, or within the Pliocene or later Tertiary, there would inevitably have been far greater resemblances between the faunas of these separated regions than actually exist. In other words, the hypothesis did entirely too much. It would be a great deal more difficult to explain the differences that now exist in the faunas, under this hypothesis, than it is to explain the facts for which it was created.

The next hypothesis involving this portion of the globe was by geologists, and was based entirely upon geological and not zoological reasons. Quite a number of years ago it was found by Indian geologists that the Upper Paleozoic and Older and Middle Mesozoic formations of other countries (that is, the Permian to Jurassic inclusive) are represented in peninsular India by a great system of rocks, chiefly sandstones, known as the Gondwana system. This system of rocks is entirely fresh-water in origin, and it appears to have been deposited by rivers. In the Indian Gondwana, animal remains are rather rare; but they consist of reptiles, amphibians and fishes. Plant remains, however, ferns, cycads, and coniferous trees, exist in profusion; and in the lower part of the Gondwana system they form coal beds sufficiently thick to be workable. In South Africa there is a series of beds known as the Karroo beds; a fresh-water formation, also, occupying a large part of the interior of Natal, and what was once the South African Republic. It is succeeded to the south, however, by a comparatively narrow strip of marine beds. Now the plants and animals of the Indian Gondwana series and the African Karroo series are in some cases of exactly the same species; in others they are closely related species. This extremely close relationship between the Indian beds and the South African beds is quite inexplicable except on the theory that there was direct land communication between these points over what is now the Indian Ocean. There is also considerable other evidence. In eastern Indian and in southern Africa we have marine beds of late Cretaceous and early Jurassic age which contain exactly the same fossils. Then we have in western India other beds of the same age, but containing different fossils, identical with fossils that are found in northern Madagascar and in European strata. This would go to show that there has been land connection in some manner between central India and Africa, and that the reason why the marine beds in eastern India and South Africa have identical fossils in them is that they simply are two pieces of one former coast, whereas the beds of western India, northern Madagascar and Europe are parts of another sea; so that they would naturally have a large number of species in common, just as we find a good many shells on our New Jersey shore the same as those shells you may pick up on the Florida beaches. The argument from this is extremely strong for the former existence of a land extending from South Africa to Ceylon, through what is now the Indian Ocean. What is now the western part of the Indian Ocean was a deep bay or gulf, which opened out into a European sea which was more or less filled with islands.

This theory of "Gondwana Land," as the connecting bridge of land has been called, we owe to the Australian geologists Zuess and Neumayer and to the English geologist R. D. Oldham, Superintendent of the Geological Survey of India. It will be seen that the theory rests upon very solid geological grounds. Another line of evidence for the existence of Gondwana Land is found in the still living fauna. Now on the Mascarene Islands, Rodrigues, Bourbon and Mauritius,

and on the Seychelles Islands in the Indian Ocean, we find frogs related to those of India. Frogs, like all other amphibians, are peculiarly sensitive to salt water. It is almost inconceivable that they should have been carried over sea; and they are also an ancient group, going back to the Jurassic age. There are also various other Indian or Ceylonese amphibians found on these islands and a number of genera of land snails.

The probabilities are, then, that the Oriental region was once a larger land mass which extended south-eastward toward Australia, and also toward the south-west to South Africa. This was from some time in the Paleozoic age on through the Mesozoic, which is about as far back as we can go with any certainty. According to Oldham, the Gondwana Land connection was submerged at the beginning of the Eocene, the dawn of the modern period. The final breaking up of the East Indian Archipelago took place, no doubt, in the late Tertiary, as is shown by the close affinity between the animals of the different islands. It is not unlikely that the evolution of man took place somewhere in this tract. It will be remembered that a few years ago Dr. Eugene Dubois, a Dutch army surgeon, found remains in Java which he considered to belong to a very ancient type of man and which he named *Pithecanthropus erectus*. These remains were taken to Europe, and the scientists who saw them, with very few exceptions, agreed that they really did represent a primitive type of man; so that it is not at all improbable that the origin of man took place in the East Indian area and that some time we will get all the fossils to show the connecting links.

Turning to the continent of Africa, we find that the fauna of invertebrate animals and lower vertebrates such as fishes, and the fauna of higher animals such as mammals, have had wholly different histories in this continent. The fresh-water fishes of Africa (as Guenther pointed out long ago) have affinities with those of South America and India. The connection with South America is accounted for by some by supposing that there was a former land bridge across the Atlantic at the same date as the Gondwana bridge across the Indian Ocean; but the evidence for this is less strong than that for Gondwana Land. The fish fauna of tropical Africa has absolutely nothing to do with that of Europe. In its land mollusks the African fauna is strongly individualized, although it has certain affinities to that of southern India. They have no connection whatever with the mollusks of Europe.

This strong individuality of the fish and mollusk faunas would indicate that Africa was an old land upon which a special fauna of its own has been developed, but which received a strong strain of Oriental forms through the connection with India by way of Gondwana Land, and also, in more recent times, from India by way of Arabia. The African forms still extended into Arabia, and some even as far as Palestine.

When we turn to the mammal fauna of Africa we find entirely different affinities. Tropical Africa, as every one knows, has a very rich mammal fauna consisting of edentates such as the aard-vark and the scaly ant-eater, and of lions, hippopotami, elephants, antelopes and giraffes; but there are no bears and no deer. In the European Miocene we have a fossil fauna very much such as we find in Africa at the present time. There were apes and large carnivores, hyenas, elephants, horses, hippopotami, rhinoceroses, giraffes and quite lately an aard-vark (an edentate) has been found in the island of Samos (Greece) in Lower Pliocene strata.

In India south of the Himalayas there is also a very similar fossil fauna to that of Europe, with some special forms; but it occurs later in date than the European fauna. What is Miocene in Europe is Pliocene in southern India, and still living in Africa. The indications are that as the sub-tropical climate which reigned in Europe in the Miocene became cooler and cooler in the Pliocene, this rich mammal fauna was driven southward and entered both India and Africa. There is good evidence that in the Pliocene the Straits of Gibraltar were not in existence; the Mediterranean Sea was bridged at that point, and also from Italy and Sicily through Malta to Tunis; and the migration may have been partially in that direction, partially by way of Arabia. The mammal fauna of Africa, therefore, dates from comparatively very recent times, and came largely from Europe; while, as we have seen, the fauna of lower animals has no connection with that of Europe whatever. Its relations are with Asia, excepting where the animals are peculiar to Africa.

To briefly summarize the history of the great continents of the Eastern Hemisphere, it may be seen that we have reason to conclude that in Mesozoic times southern Asia and the East Indies, and extending to South Africa, was one great land mass; and there was another in Africa, with minor land masses in Europe. The evidence of a connection of the Indian or Oriental land mass with the African by a strip of land called Gondwana Land is extremely strong. This is one of the most probable of hypotheses. Australia had previously been separated from the Oriental land; then Gondwana Land sank beneath the waves. Only in comparatively recent times free communication has been established with Europe. It is to these facts that we owe the complex nature of the African fauna, in which the lower animals have had a history different from that of the higher animals. Finally, in the later Tertiary, the continents acquired their present geographic forms, and the faunas assumed their present complexion.

LIFE IN AN OASIS.

The journey to that charming retreat, the oasis of Biskra, in the Algerian Desert, on the edge of the Great Sahara, is not at all arduous, and can be accomplished direct from London in four days, the through ticket costing a little over \$60, says *The Pall Mall Gazette*. From Marseilles the comfortable steamers of the Transatlantique Company leave once a week direct for Philippeville, and once weekly via Bona, the direct crossing taking thirty hours. From Philippeville Biskra is reached by rail in a day. Most travelers will prefer to break their journey at Constantine, that inland Gibraltar, whose splendid situation, en-

* A lecture delivered at the Academy of Natural Sciences of Philadelphia, by Henry A. Pilsbry, Conservator of the Conchological Section, specially reported for the *SCIENTIFIC AMERICAN*.

throne on its isolated plateau of rock, is unique in the world. Interesting as it is, however, it unfortunately lacks good hotel accommodation, an accusation which cannot be urged against Biskra, which possesses at least one first-class hotel in the Royal, and several others, the Victoria, the Oasis, the Des Zibans, etc., clean, comfortable, and moderate enough to suit every one's means. The Royal is the most modern, and has a large inner court laid out as a garden, an extensive flat roof, and a minaret, whence the gorgeous desert sunsets can be viewed to perfection, and a splendid view from the terrace eastward, over the bed of the river, the Oued-Biskra, to the Sahara and the picturesque range of hills, the Djebel-Metilli, on the horizon. The Dar-Daif Hotel, attached to the Casino, has an excellent restaurant and café, the prices at all these hotels ranging from twelve to sixteen francs a day. At Biskra it rarely rains, though heavy tropical showers are not unknown; bright sun and blue sky are the rule; there is no damp, and the pure, dry air of the Sahara is of incalculable benefit to seekers after health. Yet it has by no means the appearance of a resort of invalids only; the little town wears a gay French air, has excellent shops and bazars, public gardens, in which roses, heliotrope, hibiscus, and bougainvillea vie in profusion and coloring; a highly Oriental-looking mairie, a French fort, garrison and military club, all picturesquely contrasting with the Arab life, which to unaccustomed northern eyes is the great and salient novelty of the place. Very quaint and interesting are the native streets, the market square with its huddled groups of white-robed Arabs, the languid processions of laden and weary camels, the tunnel-shaped avenues of mimosa, and the villages scattered about the oasis, screened and overhung by countless waving date palms, not less countless to the enchanted traveler because his guide, with frigid accuracy, informs him that the oasis contains not less than 160,000 of these self-same palm trees. In this indolent land there is yet plenty for the energetic to do; the mornings can be pleasantly occupied by bathing at the Hammam-es-Salahin, six kilometers out in the desert, where there is a miniature bathing establishment built over the springs, which have a natural heat of 112 degrees Fahr. As this heat is, however, extremely enervating to the bather, it is advisable to order the bath beforehand and to allow it time to cool to a reasonable temperature. The tramway which runs to the baths passes first under palms and mimosa through the exquisite oasis of Beni-Mora, out into the desert, taking about three-quarters of an hour.

In the afternoon there are excursions, driving, riding on horses or camels to the environs and to the neighboring oases, and, after dinner, concerts, operettas, *petits chevaux* and baccarat at the Casino, or visits to the numerous Moorish cafés in the town, where may be seen the native girls dancing their strangely monotonous Arab dances to the no less monotonous accompaniment of Arab music, strident tom-toms and ear-piercing pipes, intended only, one is told, as an accompaniment to the distracted thoughts of the listener, while he sips the sweetened coffee and smokes innumerable cigarettes. The rather squalid haunts of the hashish smokers may also be visited; excellent guides are to be found at the hotels, all of whom speak French, and some a little English. Travelers who visit Biskra, unless for health, usually stay a day or two only, but it is really worth a longer visit. A fortnight certainly can be pleasantly passed there, in the course of which the expedition by diligence to the important oasis and city of Fugart can be undertaken. There is also fairly good shooting within easy reach; chamois and the mouflon, which are really Barbary sheep, abound between Biskra and El Kantara, and for these expeditions the services of one of the numerous trustworthy guides can be requisitioned. A feature of Biskra is the curious villa of Count Landon, which he kindly allows to be shown to visitors during the afternoon. The various rooms are not under one roof, but are isolated and distributed in different parts of the splendid tropical gardens, in which are successfully acclimatized many rare fruit trees, shrubs, and other plants. Very charmingly do the hours slip away in these enchanted gardens, remote from the noises of the town, remote from the world. Screened from the noonday sun by the thickest tropical vegetation, one can repose in the heat of the day in the Arab salon, where daylight filters in sparingly through hanging masses of vivid bougainvilleas, stroll through groves of feathery bamboo and orange gardens golden with fruit and heavy with the voluptuous scent of blossom, and finally watch from the river terrace the scarlet glory of the sinking sun, most splendid of nature's splendid pageants, most glorious of God's many glorious gifts, transfiguring in a blaze of rose-colored fire the gray-silhouetted outline of the distant Djebel-Metilli, and touching with magical rays the golden waves of the Sahara and the island oases of Lalla and Filiash.

This same sunset hour is one of the daily charms of life in the desert, and the northern traveler must stand spellbound before such a riot of southern coloring.

CHRISTMAS ISLAND.

An abstract in The American Journal of Science for July, 1900, gives some interesting particulars in relation to this island, which until recently was little known, but which has acquired some commercial importance owing to the discovery of large deposits of phosphate. The abstract is from a monograph by Charles W. Andrews, of the Geological Department of the British Museum. The unique character of Christmas Island, in its position, history and life, gives peculiar interest to this account of the results obtained from the ten months' vigorous explorations made by Mr. Andrews.

Christmas Island has an area of 43 square miles, and rises in places to a height of 1,000 feet; it is covered with a dense tropical vegetation. It is situated in the eastern part of the Indian Ocean, 190 miles to the south of Java, 900 miles northwest of the coast of Australia, and 550 miles east of the atolls of Cocos and North Keeling. The submarine slopes about it are so steep that a depth of 1,000 fathoms is found within two or three miles of the coast, while to the north, a depth of 3,200 fathoms was found (Maclear

Deep), and to the south and southwest, of 3,000 fathoms (Wharton Deep). The island is described as forming the summit of a submarine peak, the base of which rises from a low saddle which separates the two abysses named, and on the western end of which the Cocos-Keeling Islands are situated. Its peculiarly isolated position, hence, is most striking. Its history is also unique, since, although known to navigators since the middle of the seventeenth century, no one seems to have penetrated into the interior until 1887, and, as remarked by Dr. Murray, down to a few years ago it was probably the only existing tropical island of any large extent that had never been inhabited by man, savage or civilized. Its animal and vegetable life, therefore, are thus far almost unchanged by the conditions introduced by human life.

Geologically, the island consists largely of elevated Tertiary limestones with extensive series of eruptives; briefly, it may be considered as an ancient atoll raised to a considerable height above the level of the sea. The "central nucleus" is made up of compact yellow limestone, in places very hard and showing no traces of bedding or jointing. This is referred to the Eocene (or Oligocene) and is accompanied by basalts and trachytes, both beneath and between the beds. The total thickness of these older Tertiary and accompanying volcanic rocks is estimated to be 600 feet. Forming the mass of the island is the Miocene Orbitoidal limestone, separated from the older rocks by basalts and basic tuffs. The higher elevations are dolomitic limestones containing 34 to 41 per cent of magnesium carbonate; these show traces of coral structure and imperfect remains of Foraminifera. Thick beds of phosphate of lime, in part limestone beds altered by overlying guano, in part phosphatized volcanic tuffs, occur on some of the elevated points and have proved to be of economic value. The Tertiary limestone, especially the Miocene, forms abrupt vertical cliffs, sometimes 250 feet in height, along a large part of the coast line. A series of terraces is also noted around the shore and outlying the whole is the fringing coral reef. Mr. Andrews remarks upon the remarkable development of elevated Tertiary rocks and the difficulty in explaining their deposit over an area so isolated. He adds that the great thickness of reef limestone, required by the Darwinian theory of atoll formation, is not found, and although there may be some evidence that subsidence did occur in the history of the island, it is clear that it was not for any long period nor of any great extent. It is interesting to recall in this connection the similar observations recently made by Agassiz on the elevated Tertiary limestones of the Fijis and other islands of the Pacific.

SIR FRANCIS BARRY'S NEW EXCAVATIONS OF BROCHS.

TACITUS, to whom we owe the most valuable work about our early history—namely, "The Germania"—was the son-in-law of Agricola, the Governor of Britain and army leader, who penetrated as a conqueror into that eastern part of Scotland once called Caledonia. "The Life of Agricola" is from Tacitus' pen. Evidently from his father-in-law's own statement, who through prisoners of war and interpreters could certainly obtain the best information—more especially so as numerous Germans served in his army—Tacitus reports that the red-haired, large-limbed barbarians of Caledonia (that is, strictly, of Eastern Scotland) had the marks of their Germanic origin. To attempt setting aside such clear testimony requires a great deal of boldness—not to say presumption. The kindred racial character of the Caledonians did not prevent the Teutonic auxiliaries of Agricola from fighting against them on the Roman side, as well as against the Celtic and Iberian tribes of Britain.

I [says Karl Blind, in The Gentleman's Magazine] had an excellent opportunity for renewing old studies concerning the early connection of Germany with the conquering Italian armies in this country, when I was on a month's visit at Capheaton Hall, in Northumberland, the beautiful country seat of Sir John Swinburne, the former Liberal member, whose hospitality I shall not easily forget. Capheaton Hall is stocked all over with valuable books in many branches of knowledge. In its neighborhood, in the last century, some precious Roman metal-work, partly representing mythological subjects, has been found, which may be seen in the Anglo-Roman Room of the British Museum. During the stay at Capheaton Hall we inspected the famous Roman wall which once served as a boundary and defensive work against the fierce warrior tribes of Northern Britain.

In a few crevices of that wall we saw a curious little flower sprouting forth, which is not to be met with anywhere else in this country. It attracted at once the attention of Sir John Swinburne's late charming wife, who would have liked to get a sample. By the guide we were, however, told not to root up any specimens of the rare plant. It came originally by the Romans from Spain. In the neighborhood of the wall there were once placed various cohorts of German soldiers: Batavians, Frisians, Tungrians, Nervians, Vangions; also Thracians, eastern kinsmen of the Teutons and Scandinavians. This fortification of yore extended from the mouth of the Tyne, at the German Ocean, to the Solway Firth in the west. A number of place-names are still in existence which refer to the wall, such as Walton, Walwick, Walhouses, Wallfoot, Wallhead, Wallsend, and many others. The wall was at first the Roman *limes*, or frontier, in Britain. Afterward another fortification of a similar kind was erected, still more toward the north.

Among the German auxiliaries or mercenaries of the Roman army in Britain there sometimes occurred, it is true, dangerous mutinies. Thus we read in Tacitus and Dion how a cohort of Rhenish Ulpianis, which had been levied in Germany, one day killed the centurion and some soldiers, their instructors in military discipline, and then seized three light vessels, forcing the masters to go on board with them. Finally, these shipmasters, too, were killed. The Germans, driven at the mercy of the waves, and fighting several times with the natives on the shore, sailed from the west, round the Hebrides, and through the Pentland Firth, into the German Ocean and the Baltic. At sea their sufferings became such that they had to feed upon

each other by lot. Being regarded as pirates, they were intercepted by the Suevians and the Frisians, and, in spite of their German nationality, sold by these as slaves. In the end, through repeated changes of masters, they came again into the possession of the Romans on the left bank of the Rhine.

This striking adventure merits attention. It is one of the many cases of early German acquaintance with that Britain which in later centuries was made into an "England" by Frisians, Angles, Saxons, Rugians, Huns, and other Teutonic warrior-clans, whose forefathers had learned a great deal about this country in the military service of Rome.

Five German cohorts, composed of Batavians and Tungrians, fought under Agricola, in the greatest battle against the Caledonians, in the foremost ranks. Their bravery during a most terrible hand-to-hand encounter decided the victory. The description of this struggle, as given by Tacitus, is one of the most graphic. "The legions," he says with Italian artfulness, "were placed in the rear, before the entrenchments—a disposition which would make the victory eminently glorious if it were won *without the expense of Roman blood*, and which would insure support for the remainder of the army were driven back." Upon the Germans the Roman general chiefly relied. They were put in the forefront. The Teutonic Batavians, striking with the bosses of their shields and mangle the faces of the enemy, bore everything down by their impetuosity. In all the "Annals" of Tacitus, there is not a more vivid battle-picture than this one of the battle of the Grampians.

As far as the northernmost parts of Scotland, Frisians have penetrated as conquerors since ancient times. From them Freswick Bay has its name. Literally, Fres-Wick means the Frisian Bay. The addition of the word "bay" is merely an amplification, or tautology, which arose when the meaning of "wick" was no longer understood. There are many bays called "wick" on the Scandinavian as well as on the German coasts, in the German Ocean, and in the Baltic, where we find the Tromper Wick, the Schwanen-Wiek, the seaside place Wyk or Wik on the Isle of Föhr, and many more similarly called. These names have nothing to do with the Latin *vicus*, from which, no doubt, a number of other place-names in this country have their ending syllables.

From the Germanic word "wick" the Vikings, or Wickings, are named—that is, bay-men watching in creeks for their opportunities. Often the word Viking (erroneously pronounced vi-king, instead of viking) is translated in English by "sea-king." A Viking may have been a king, or rather an aristocratic chieftain, but he may as well have been a simple freeman; and the mass of them were nothing else.

THE MINERAL CONSTITUENTS OF DUST AND SOOT FROM VARIOUS SOURCES.*

NORDENSKJÖLD collected and described three different kinds of dust; one consisted of diatoms, a second of a siliceous and apparently felspathic sand, both from the surface of the ice in Greenland, while a third consisted of sooty-looking particles composed of elements invariably associated with iron meteorites and of uncommon occurrence in terrestrial matter, namely, beside metallic iron, cobalt, nickel, carbon, silicon and phosphorus. He concluded that it was meteoritic matter showered down upon the earth, and that cosmic dust is falling imperceptibly and continually.

A great variety of mineral matters, including dust from various sources, having been examined spectrographically by the authors, they give an account of its composition. Specimens which fell from the clouds were compared with those from known terrestrial sources. The first comprised (1) solid matter forming the nuclei of hail-stones collected during a storm on April 14, 1897; (2) solid matter from hail and sleet collected during a heavy shower from 2:30 P. M. to 3 o'clock on March 28, 1896; (3) pumice from the Krakatoa eruption of 1883. These were examined for Prof. J. P. O'Reilly, who had collected them. (4) Dust from a dish exposed on November 16 and 17, 1897, in the outskirts of Dublin; and other samples with a similar origin which had fallen into porcelain dishes placed on a grass-plot in a garden. Varieties of flue-dust, (4) from Crewe gas-works, (5) iron-works, (6) sulphuric acid works, and (7) copper smelting works, (8) volcanic dust from three different sources, (9) soot from laundry, laboratory, kitchen and bedroom chimneys. Flue-dust is characterized by the larger proportions of lead, silver and copper than other varieties of dust and coal ashes contain. Nickel and manganese are notably present, but the most striking feature is the quantity of dubidium, gallium, indium and thallium in all samples. Volcanic dust shows the bands of lime and magnesia with strong spectra of the alkali metals, and these are evidently its leading basic constituents.

Soot is of variable composition, not so much with respect to the substances present as to the relative proportions of each in any two samples. Its larger proportion of lime distinguishes it from dust collected from the heavens. Nickel, manganese, copper, silver and lead are constant constituents. The presence of nickel is probably due to minute quantities of this element being disseminated in coal, which is first converted by the carbon monoxide produced in the fire into nickel tetracarbonyl, which is naturally volatile, but subsequently becomes decomposed and nickel or nickel oxide is deposited.

Dust from the clouds, collected either by itself or in hail, snow, sleet, or rain, exhibits a regularity in composition not seen in other varieties of dust. It contains, apparently, the same proportions of iron, nickel, calcium, copper, potassium and sodium. The chief difference occurs in dust suddenly precipitated in sleet, snow and hail, since lead is found in larger proportions in these, and particularly so in one specimen from sleet.

It is evident that the presence of nickel is not positive evidence that the dust from the clouds comes from other than a terrestrial source.

The dust which fell on November 16 and 17, 1897, with its similarity in composition to that of meteorites,

* By Prof. W. N. Hartley, F.R.S., and Hugh Ramsay. Abstract of a paper read at meeting of the Royal Society, February 21.

its being attracted by the magnet and its appearance are quite in favor of its being of cosmic origin. On the other hand, in its composition it is unlike volcanic dust, flue-dust or soot.

(Continued from SUPPLEMENT, No. 1321, page 21173.)

A GENERAL SURVEY OF FOREIGN TRADE.*

DISTRIBUTION OF OUR EXPORTS.

A GLANCE at the accompanying map of the world, showing the distribution of our exports of manufactures, reveals the significant fact that, as yet, the widest range of consumption of our goods is found in the leading industrial countries, such as Great Britain, Germany, France, and their willingness conjoined with their greater capacity to take our products raises the interesting question whether our activity in competing for neutral markets, such as China, Africa, South America, etc., is not, for the present, restrained by the fact that our energies are largely employed in manufacturing for the European demand. The seriousness of our competition in the development of trade in countries which, as yet, are but imperfectly exploited will begin to be fully felt, it would seem, only when the European demand shall have slackened or we shall have more than met its requirements. In that case, our exporters would undoubtedly address themselves more systematically and with greater energy to trade regions which our European rivals are now so industriously seeking to control. There is food for thought also in the possible consequences to our European trade of a rivalry on our part which may be so crushing as to greatly impair the purchasing power of those who are now our best customers. If we permanently cripple their chief industries, we deprive them, to a greater or less extent, of the means of buying from us, and the consumption of our food supplies and our raw materials, as well as of our finished goods, may be greatly curtailed. The solution of the problem may perhaps be found in the gradual specialization of commerce and industry, according to the peculiar capacity of each competing nation—the survival, in other words, of the fittest conditions for this or that country—and the gradual subsidence of competition into healthful exchange.

AMERICAN AND AFRICAN TRADE.

The annual reports of the United States consular officers, as summarized in the Review of the World's Commerce, are supplemented with the latest data obtainable from official and other reliable sources in foreign countries; presenting, substantially, contemporaneous pictures of trade and industrial conditions throughout the world. Taking the great geographical divisions in alphabetical order, we find that Africa is rapidly becoming a promising field for American enterprise wherever artificial restrictions are not imposed. West Africa, as we have seen, has come to the front as a serious quantity. There is, says Consul Williams (Sierra Leone), an increasing demand for American goods, and an agency has been established. In South Africa, the war has, of course, deranged trade; but in 1899, the United States exported \$10,000,000 worth of goods to Cape Colony and \$3,250,000 worth to Natal. A marked advance in imports from the United States is noted in agricultural implements, machinery, and vehicles, besides food supplies, and Consul-General Stowe is sanguine of a great increase of American trade when peace shall have been restored. In East Africa, it is noticeable that in Madagascar, where France imposes a tariff discriminating in favor of her own products, our cotton-goods trade, once considerable, has practically been destroyed, whereas in Zanzibar, the Somali country, and Abyssinia, where such restrictions do not exist, it continues to grow. A British Foreign Office report from the Somali Coast states that the cheaper American gray shirtings are preferred to European cloths and are very popular. They form the ordinary wearing apparel of the inland Somali. The two largest items of trade—the import of gray shirtings and the export of skins—are entirely in the hands of Americans.

In America, we still control more than half of Canada's trade, though trade with Great Britain is growing because of the preferential tariff of 33-1-3 per cent in favor of English goods. With Mexico, our trade relations continue to be most satisfactory. During the fiscal year 1899-1900, we took 77 per cent of Mexico's exports and sold her over half of her imports. Capital from the United States is flowing into the country, and the recent industrial growth has been remarkable. Our goods seem to be making steady progress in Central America—especially in British Honduras, Costa Rica, the Republic of Honduras, and Nicaragua. We have lost ground somewhat in Guatemala, though we sent nearly one-half of her purchases in 1899. Great Britain, upon the other hand, increased her sales by about \$134,000. Salvador imports only something over two-thirds as much from the United States as from Great Britain, although we take twice as much of her products. A notable fact about Central America is the increasing investment of German capital in commercial enterprises, especially in Costa Rica, Guatemala, and Nicaragua—which is estimated to amount to some \$67,000,000—and the encouragement given to Germans to emigrate to Central American countries.

With the West Indies, especially the British islands, our trade is constantly growing. In Jamaica, we have 64 per cent of the imports, against a little over 33 per cent from Great Britain. Generally speaking, the West Indies may be said to draw the bulk of imported food supplies from us and an increasing proportion of manufactured goods as well. To Haiti, we furnish 66 per cent of the imports, though nine-tenths of the exports are sent to Europe. Our consul at Copenhagen, Mr. Freeman, reports under date of December 20, 1900, that "seven new steamers have just been ordered for the fruit trade between the West India Islands and the United States." "The contract for one of them—the 'Taunton'—with the option of two others," he adds, "was signed to-day between the United States Fruit

Company and Messrs. Burmeister & Hains, extensive shipbuilders of Copenhagen. Three of the seven will be built in England, three in Norway, and one in Denmark, with a possibility of two more at Copenhagen. The United States Fruit Company has already over twenty steamers in the banana trade from the West Indies to American ports. These vessels are registered as Norwegian, but it is understood that the bulk of the capital invested is American."

In Cuba and Porto Rico, sufficient time has not yet elapsed for recuperation from the war and the readjustment of industrial and commercial conditions, but in both islands, trade is beginning to revive, with the promise of gradual development on lines of closer intimacy with the United States.

In South America, as has been shown, our trade has developed but slowly, except in the Argentine Republic and Peru. In 1899, the imports of Argentina from the United States increased by over \$4,000,000. We now stand second in imports, though we still have but little over one-third of Great Britain's share. We exceed Germany by about \$2,500,000 and Italy by \$1,800,000. The imports from France are comparatively insignificant. As heretofore stated, our commerce with Peru increased from \$1,588,000 in 1897 to \$3,491,000 in 1899. During the first eleven months

three-fourths of Germany's share. In Colombia and Venezuela, trade has suffered recently from political disturbances; in Ecuador, we had about 22 per cent of the exports during the first six months of 1900. In the Guianas, we take nearly as much as England from the British colony, but sell only half as much; and we export but little more than one-fourth of the Dutch colony's purchases, though we buy more than half of its total exports. Holland, upon the other hand, takes only one-third of the exports and has more than half of the import trade. In French Guiana, the imports are almost wholly from the mother country. With Paraguay, our trade is still insignificant; but in Uruguay, Consul Swalm notes a steady expansion of the United States trade and increasing popularity of American goods.

The burden of most of the consular reports from South America is the need of better facilities of steamship communication with the United States and of American banking institutions, enabling us to establish closer and more systematic relations.

AMERICAN GOODS IN GREAT BRITAIN.

Our consular officers in Great Britain continue to report the steady progress of American goods in popular favor. Consul McFarland, of Nottingham, under



UNITED STATES MANUFACTURES IN THE WORLD'S MARKETS.

of 1900, our exports thither amounted to \$1,981,642, against \$616,559 for the whole of the calendar year 1893. With Bolivia, our trade is still trifling, the import business being largely in the hands of Germans, owing partly to the cheapness of their goods and partly to German immigration. Brazil sent us \$60,000,000 worth of her products in 1899 and took less than \$12,000,000. Great Britain, importing but \$20,000,000, sold Brazil \$27,000,000 worth of goods. Germany sold Brazil about half of what she bought; France, a little less than four-fifths. Belgium, importing a little over \$2,000,000, sold more than \$10,000,000. The United States ranks only sixth among the nations selling to Brazil, though it buys more of Brazil's staples than all Europe combined. Brazil has been passing recently through a period of commercial depression, but Consul Furness, of Bahia, reports a better outlook for the new year. Consul Gun-saulus attributes the slow progress of American trade with Brazil in great part to the need of better transportation facilities and to the fact that all railroad and banking institutions, as well as many other large enterprises, are controlled by European capital. In Chile, Great Britain still has the largest share of the imports (about \$16,000,000 in a total of \$39,000,000) and takes more than two-thirds of the exports. Germany comes next in sales to Chile, and the United States third, with \$3,000,000, or but little more than

date of December 17, 1900, notes the interesting fact that in Leicester, the seat of two great industries—the manufacture of boots and shoes and of hosiery (including underwear)—American footwear and hosiery are being sold in the retail stores, and much of the machinery now used in the shoe factories is of American make. Other consuls report increases in British imports of American shoes, furniture, agricultural implements, tools, flour, electrical appliances, etc. The demand for American hardware is large and growing, especially for refrigerators, steam valves, radiators, and lawn mowers. Our engineers' machinery and tools are acknowledged to be far ahead of any others and command an ever-increasing sale.

AMERICAN MACHINERY IN FOREIGN FACTORIES.

The introduction of American machinery and tools, indeed, is becoming quite common both in England and upon the Continent. The results in cheapening and improving factory products find a notable illustration in the manufacture of firearms at Liege, Belgium. According to Consul Winslow, American machinery has worked marked changes there, bringing about a great reduction in cost and turning out better weapons because the different parts can now be made interchangeable. The ultimate effect of the adoption of our labor-saving appliances and methods will probably be to reduce the present disparity between American and

* Extract from the Review of the World's Commerce, introductory to Commercial Relations of the United States, 1900 (in press). By Frederic Emory, Chief Bureau of Foreign Commerce.

European manufactures resulting from the superiority and greater cheapness of our product; but the process of adaptation in the more conservative industrial centers of the Old World must be slow, and in the meantime, our manufacturers will doubtless continue to reap a rich harvest in Europe, as elsewhere. The interesting deduction obviously suggests itself that improved machinery, which was once regarded as the foe of labor—and is still so regarded by some of the labor organizations of Europe—has proved itself to be the most trenchant weapon of American workingmen in the competition for foreign trade.

INDUSTRIAL CONDITIONS IN CONTINENTAL EUROPE.

Taking up the continental countries of Europe in alphabetical order, we find that in Austria-Hungary, during the first few months of 1900, great depression prevailed in all branches of trade. It was caused to a considerable extent by the great coal strike in the spring. Toward midsummer, conditions improved and the Empire began to export more largely. Strong efforts to promote manufactures are being made by the government.

From Belgium, our consuls report that it is doubtful whether the great industrial development can be maintained at its present point. Depression is beginning to be felt, and undertakings in foreign lands—Russia, the Congo, China—have taken a considerable amount of capital out of the country, affecting the value of agricultural properties. In 1900, the United States sent to Belgium increased quantities of barley, wheat

advantages over us, in the opinion of Mr. Mason, are higher technical and mercantile education, "cheaper and more tractable labor," and a merchant marine capable of carrying her products to every market on the globe.

In the Netherlands, American tools are in general use. Our steam pumps, woodworking machinery, etc., are gaining a foothold. Stoves made in Germany after American patterns are supplanting ours, because cheaper. Our office furniture, bicycles, and typewriters continue to meet with favor. American showrooms have been opened in Rotterdam.

Russia, as has been shown in previous Reviews, is engaged in great industrial enterprises and is making rapid progress in the development of her natural resources. She seems especially inclined to take American goods and to welcome American capital and enterprise. Her finances are described in a recent report by her financial agent in Washington, Mr. de Routschewsky, to be in a satisfactory condition. The revenues, he states, are not only amply sufficient to meet the annually increasing ordinary expenses of the government, but give large and yearly increasing surpluses which allow the government to make profitable investments in building railroads, harbors, and other public works. Our consul-general at St. Petersburg, Mr. Holloway, calls attention to the fact that, owing to lack of direct communication, many American goods enter Russia via other countries and are not classified as imports from the United States. During the fiscal year ended June 30, 1900, our exports to Russia

sugar mills throughout the country." Our consuls in Spain express the opinion that there is a profitable market there for American goods, and a movement has been set on foot at Madrid for the co-operation of American and Spanish capital in the establishment of an exhibition of those of our products which are likely to meet with favor.

In Sweden and Norway, and also in Switzerland, there is growth in the importation of American manufactures, and the prospect of steady development is reported to be encouraging.

From Turkey, Consul-General Dickinson, of Constantinople, sends the intelligence that, owing to the establishment of a direct line of steamships from New York, there has been a gratifying increase in the amount and variety of American goods at levantine ports, and the exposition and agency at Constantinople for the sale of our products, which was established in 1899, "is already a success and has outgrown the expectations of those who are conducting the business."

COMMERCIAL POSITION OF THE UNITED STATES.

In short, it may be said that nowhere does the United States appear to disadvantage in foreign trade, and, to quote The London Statist of December 29, 1900, "its ability to compete in the foreign markets with the most advanced nations of Europe has been strikingly displayed."

PROGRESS IN CONSULAR WORK.

The progress noted in last year's Review in the work of the consular service in promoting American



STATES MANUFACTURES IN THE WORLD'S MARKETS.

Inquiries have been made from the prospect of the coming almond crop in this district. It is considered too early here to speak with any confidence of the crop. Indeed, I am assured by experts that nothing positive can be said before the 1st of May. In so far, however, as one can vaguely judge at this time, the crop is fully as promising as at the same period of last year; but the winds of March and April are to come yet, and until they have passed nobody knows what the almond crop will be. Incidentally, I may state that it is likely the frost has done some damage in the neighborhood of Granada, but probably not to any great extent. Of last year's crop of almonds, many boxes still remain in Malaga unsold on account of the high prices demanded. This fact, perhaps, has influenced certain persons to assume that the almond crop this year will be small, but there is no valid reason for any such conclusion.

Exhibition in the Azores.—I am in receipt of an official letter notifying me that it is the intention of the authorities of this island to inaugurate a grand fair, or exhibition, in honor of the first visit of the King and Queen of Portugal to the Azores, says Consul George H. Pickrell, of St. Michael's. The official programme puts the date of their appearance in St. Michael's at July 1, 1901, and it is intended that the King will open the fair in person. It will last three weeks.

Undoubtedly, this will attract a large number of people from the other islands, and it seems to me that it would be an excellent opportunity to exhibit some of the many things for which we are celebrated.

Unfortunately, the plans of the fair association do not embrace buildings for the exhibition of foreign manufactures; but I am assured by the director, Dr. Aristides Moreira da Motta, that, upon proper application, space would be provided for such a building, should foreign exhibitors care to erect one. Dr. Motta

amounted to \$7,438,317, against \$5,957,856 in 1895; our imports in 1900 were \$7,245,973, against \$3,575,388 in 1895.

In Spain there are signs of industrial development due to the transfer of capital and industry from colonial to home enterprises. From this, it would appear that the loss of her colonial possessions has been economically beneficial to Spain, instead of injurious. Our consuls report that the Kingdom has recently received large amounts of French, Belgian, English, and German capital investing in railways, mining, beet-sugar production, electric plants, and banking. Besides these, it is estimated that 500,000,000 pesetas (about \$80,000,000) of Spanish capital formerly invested in the colonies has gone into home industries. Since the Spanish-American war, writes Vice-Consul-General Hanauer, of Frankfurt, September 11, 1900, the internal affairs of Spain have greatly improved and a healthful development of her resources has begun. This has especially shown itself in efforts to develop mineral wealth. Foreign capital has embarked largely upon this branch of Spanish industry. Consul-General Lay, of Barcelona, reports, November 22, 1900, that "since the West Indian colonies were lost, the production of beet sugar in Spain has almost monopolized the attention of Spanish agriculturists. Large capital has been subscribed for the purpose of cultivating beets on an extensive scale and of erecting

industries and trade is emphasized by the increased number of letters from leading business firms and trade bodies during 1900, commending the zeal of consular officers and testifying to the practical utility of their efforts, as well as by the continued assertion by expert opinion abroad of the superiority, both in character and promptitude of publication, of the United States Consular Reports. Thanks to the general improvement and quickened zeal among consular officers in preparing their annual reports, the Bureau of Foreign Commerce is enabled this year to publish Commercial Relations about a month in advance of the usual time, and thus to practically reach the goal contemplated in the instructions of the Department—the transmission to Congress on or about the 1st of January of "a comprehensive statement of the trade, not only of the United States with the rest of the world, but of the various countries with each other."

A FEW VACCINATION STATISTICS.

The following statistics are culled from an able article on the subject written by Dr. C. D. Smith, president of the Board of Health of the State of Maine, says The Medical Record: The German law of 1874 makes vaccination obligatory in the first year of life, and also revaccination obligatory at the tenth year. This law in Germany resulted from the epidemic of 1871, with

its 143,000 deaths, among a population in which vaccination had been allowed to die out. Prior to 1874 the yearly loss was 15,000 to 20,000. The present rate is less than 116 a year, and these cases occur on her borders, where there is constant mingling with the poorly vaccinated of other countries. The disease does not spread or become epidemic among well-vaccinated people. It does so develop among the unvaccinated. During the Franco-German war the inevitable mingling of the two peoples spread smallpox, which was epidemic. The Germans had made vaccination optional for its civil population, but compulsory for its army, the French having made it optional alike for army and population. The French lost from smallpox 23,000 men; the Germans, 278. Occupying the same hospital tents, with the same surroundings, the French wounded lost many from smallpox; the Germans, not any. The French prisoners of war died by the hundreds; their German guards, who had been vaccinated and revaccinated, suffered not at all. In Denmark, Sweden and Norway, where, as well as in Germany, vaccination is compulsory, the annual death rate is from one to three a million.

TRANSPARENCY OF MATTER FOR X-RAYS.*

EXPERIMENTS OF THE LABORATORY OF PHYSICAL RESEARCH OF THE SORBONNE.

In previous communications I have demonstrated the heterogeneity of the X-rays and the selective absorption exercised by the bodies that they traverse. I have considered the influence of the nature and density of certain substances on that absorption. I have shown that, with some exceptions, the transparency is not only a function of the mass, but that the *absorbent power* or *specific opacity* usually increases rapidly with the density. Finally, I have observed that bodies possess a property which can be called their *radiochromism*, because it is comparable to the color of certain transparent substances in the light, and that in consequence the relation of the *opacities* of two substances changes with the mass traversed and with the quality of X-rays employed, the most rapid change being produced by the densest bodies.

In continuance of these researches, I proposed to extend them to the greatest possible number of substances and to the most varied conditions of thickness traversed and of the X-rays employed. The study of about 120 simple and compound bodies has thus furnished results so important and general as to allow the deduction therefrom of the principal laws of the transparency of matter under the X-rays.

Independently of an electrometric method, alone capable of determining some absolute values, I have employed the radioscopic and radiographic methods, for which I have established a system giving relative values in a manner sufficiently rapid and precise, whatever may be the physical condition and the thickness of the bodies studied. This system requires precautions for avoiding possible intervention of secondary rays, whatever may be their source.

Let us call *equivalent of transparency* of a body the mass, estimated in decigrammes, of a prism of that body having a base of one cubic centimeter and producing on the X-rays of determined quality, traversing it parallel to its axis, a definite absorption, the same for all bodies; for example, that which a prism of paraffin, 75 millimeters in height, chosen as a standard of transparency, produces.

This equivalent defines and allows the calculation of the average specific opacity of the substance considered for the particular thickness corresponding to the standard chosen, and for the particular quality of the X-rays employed.

The measure of the equivalents thus determined furnishes a certain number of interesting results, of which the principal are the following:

1. The *specific opacity* of a body (for certain conditions determined as mentioned above) seems independent of its physical condition; it is the same, for example, for water and ice. It is independent of the temperature.

2. The *specific opacity* seems independent of the method of atomic grouping; that is to say, of crystalline forms of allotropic states, of molecular condensations, and of the differences of chemical purity nearly. It is the same, for example, for anhydrous aluminium and corundum, for the diverse forms of carbon, whether crystallized or amorphous, for yellow and red phosphorus, and for some isomeric bodies, such as benzylic aldehyde, C_6H_5CHO , which gives $E = 61$ gr.; and for benzoin, $C_{14}H_{12}O_2$, which gives $E = 60.5$ gr.

3. The *specific opacity* seems independent of the state of freedom or of combination of the atoms, and the equivalent of transparency of a mixture or of a combination can be calculated by means of the equivalents of their constituent elements, making allowances, if necessary, for the difference of quality in the selective absorption; that is to say, for the particular radiochromism of these elements. It is the same for the inverse calculation. Examples:

Silicon (measured) $E = 15.7$ from whence quartz (calculated $E = 24$)
Oxygen (measured) $E = 44.5$ from whence lithium (calculated $E = 41$)
Caustic lithia (measured) 97 from whence lithium (calculated 113.8)
Oxygen (measured) 44.5 from whence lithium (measured 115)

In a word, the specific opacity, corresponding to well-determined conditions, constitutes a new additive property of bodies, as mass, atomic weight, atomic calorific capacity, with the advantage of being independent of the causes of variation.

This property, appearing to depend only on the nature of the atoms, leads to a search for a relation between the atomic weights of different simple bodies and their equivalents of transparency in certain determined conditions. Taking the atomic weights as abscissas and their equivalents as ordinates, I have been able to unite all the points obtained by a hyperbolic curve, with slight deviations, which it is possible to explain, either by a defect in the absolute purity of the samples studied, or by slight variations in the quality of the X-rays employed. At the same time I have traced the hyperbola passing through one of the extreme points, that of lithium, and having for asymptotes the axes of the atomic weights and that

of the equivalents. The two curves, perceptibly mingled for the less atomic weights, are afterward notably removed from each other, but deviate most in the region of atomic weights 40 to 50, where the apex of the curve is found.

The curve obtained represents a general law of transparency of matter for the determined conditions of thickness and of X-rays, in which the specific opacity is connected with the atomic weight by a relation generally more complex than the simple proportionality.

From these conditions we can pass to others by three principal processes; by modifying the condition of the radiogenous tube, the softening or the hardening by heat, osmo regulation, etc.; by modifying the standard thickness, which involves for the bodies studied a corresponding variation of mass, and consequently a selection more or less thorough of the X-rays which traverse them; and by interposing between the radiogenous tube and the bodies studied some screens more or less radiochroic (as lead and sulphur) and more or less thick.

Thus the equivalents of transparency increase or diminish together, but not to an extent proportional to the progressive deformation of the initial curve. In other terms a group of curves of iso-transparency are obtained, each of which represents a particular law of transparency of matter. Those removed from the hyperbola correspond to X-rays, soft and slightly penetrating; others, on the contrary, approach and embrace it even when the X-rays become hard and penetrating, or when screens most thick and radiochroic are interposed.

Hence, a fourth conclusion may be formulated:

4. The specific opacity of simple bodies, measured in well-defined conditions, is a determined function of their atomic weight, increasing in proportion for X-rays sufficiently penetrating and homogeneous.

THE SOUND LOCATOR AND PROJECTOR.

The general rules that the propagation and reflection of sound obey are well known. The laws of reflection especially are identical with those that have been ascertained for light and heat. And just as the



COWPERCOLES' SOUND LOCATOR AND PROJECTOR.

experimental verification can be made for heat by means of two concave mirrors placed opposite one another at a certain distance, just so in courses of physics are verified the laws in question, applied to sound, by suspending a watch in the focus of a mirror and listening at the focus of another mirror placed opposite, either directly by ear or through the intermediate of an acoustic tube, one of the extremities of which ends at such focus.

It is by taking these principles and this experiment as a basis that Mr. Sherard Cowpercoles, of London, has devised his apparatus for transmitting and receiving sound signals, and which, in reality, comprises two absolutely identical apparatus. We may consequently be content to give a view of but one of these apparatus along with that of an operator ready to control the motions thereof, and either to send or receive signals. The object of the apparatus is to localize the direction of a sound rapidly and to project sounds to a great distance.

As the engraving (borrowed from La Nature) shows, the instrument comprises, in the first place, a reflector in the form of a mirror mounted upon a rod, which is itself perpendicular to a horizontal arm. This latter is provided at the center with a pivot that permits it to turn in all directions in the same vertical plane and also to rise and descend when need be. The reflector naturally follows such displacements. The object of the weight beneath the rod opposite the reflector is to assure the equilibrium, and has no active role as might at first sight be supposed. Above the counterpoise arises a small rod which supports a length of rubber tubing provided with two mouthpieces, one free and the other directed toward the mirror.

The instrument is used as follows: If it is desired to find out the direction whence a sound proceeds the mirror is turned tentatively, in keeping the ear at the free mouthpiece of the tube, until the sound is heard at its maximum intensity. It is unnecessary to say that during such researches both the direction and height of the mirror must be acted upon in order to succeed in getting the sound under the best conditions.

When it is desired to establish a conversation between two more or less distant stations one of the

interlocutors, after assuring himself that the reflectors are properly directed, speaks into the free mouthpiece of his tube, while his correspondent places himself in the position shown in the figure. The inventor asserts that, under such circumstances, it is possible to converse at a long distance without raising the voice to an unreasonably high pitch.

SELECTED FORMULÆ.

Some New Cologne Formulas.—The following formulas for Cologne water are given in Profumiere Italiano for March:

I.	
Oil of bergamot	1.0 gramme
Oil of lemon	2.5 grammes
Oil of neroli	1.5 grammes
Oil of rosemary	1.0 gramme
Alcohol, 96 per cent	300.0 grammes
Orange flower water	75.0 grammes

II.	
Oil of bergamot	8 grammes
Oil of lemon	4 grammes
Oil of neroli	1 gramme
Oil of origanum	6 drops
Oil of rosemary	1 gramme
Alcohol, 96 per cent	600 grammes
Orange flower water	50 grammes

Cologne water improves with age, acquiring on keeping a characteristically delicate odor. This is supposed to be the result of a special etherification of the alcohol with the oils and resulting intermolecular changes. The manufacturers of Cologne water accelerate this change either by exposing the water in glass-stoppered bottles to the action of the sun's rays, or by warming it gently in a water bath for a period of 48 hours.

III.	
Oil of neroli	1.0 gramme
Oil of lemon	4.0 grammes
Oil of bergamot	5.0 grammes
Oil of cedar	1.5 grammes
Oil of lavender	2.0 grammes
Oil of rosemary	2.0 grammes
Melissa water (P. G.)	160.0 grammes
Alcohol	1,000.0 grammes

IV.	
("Jülichplatz, No. 4.")	
Oil of orange	2.5 grammes
Oil of lemon	3.5 grammes
Oil of bergamot	1.5 grammes
Oil of neroli	1.5 grammes
Oil of rosemary	1.5 grammes
Alcohol	370.0 grammes

V.	
("Gegenüber dem Jülichplatz.")	
Oil of lemon	350 grammes
Oil of bergamot	270 grammes
Oil of lavender	20 grammes
Oil of mint	12 grammes
Oil of neroli	6 grammes
Oil of white thyme	5 grammes
Oil of rosemary	5 grammes
Oil of rose	1 gramme
Acetic ether	12 grammes
Orange flower water	1,110 grammes
Rose water	200 grammes

Allow to macerate for one or two months, and then dilute with six to eight kilos of alcohol and distill.

VI.	
Oil of bergamot	12 grammes
Oil of neroli	6 grammes
Oil of lemon	6 grammes
Oil of mace	1 gramme
Oil of rosemary	1 gramme
Alcohol	960 grammes

VII.	
Oil of orange	24.0 grammes
Oil of lemon	24.0 grammes
Oil of bergamot	1.5 grammes
Oil of neroli	0.5 gramme
Oil of petit grain	0.5 gramme
Oil of rosemary	0.5 gramme

*Paper of Prof. Louis Benoist presented to the Académie des Sciences.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Demand for American Shoes in France.—I have been requested by Gabriel Bisellach, Abonné No. 11, Bureau Central, Marseilles, to procure for him the addresses of United States manufacturers of boots and shoes who are desirous of extending their trade to France, says Consul Robert P. Skinner, of Marseilles. Similar information would interest A. Heymann, 54 rue St. Jacques, Marseilles. These gentlemen are agents familiar with local conditions, and desire to engage in business on a commission basis. Prices should be quoted c. l. f., if possible.

In connection with this matter, I desire to say that complaint is frequently made at this consulate that American manufacturers are too much disposed to establish central agencies at Paris and to rely upon them to cover the entire French field. The result is that the Parisians are frequently unable to do justice to their great extent of territory, and are under the necessity of increasing their prices to such an extent as to interfere with successful competition in the provincial cities. Shoes imported at Paris, for example, must be sent by rail from Havre to that city, repacked, and forwarded again by rail to the ultimate buyer. In many cases, the local freight charges exceed the cost of transportation from New York to France. Marseilles, being a seaport city, with frequent means of communication with New York, offers every facility for the transaction of business between buyer and seller, and is itself an exporting port for the entire Mediterranean field.

Up to the present time, practically no effort has been made to dispose of American boots and shoes as such in this city, although various retail shopkeepers sell British foot gear, and latterly a lively trade has been created between Marseilles and the Balearic Islands. I know of but one retail dealer who advertises American shoes. This merchant, while proclaiming in large letters that American foot wear may be found within, is temporarily without anything of the sort. He was induced to undertake the sale of American shoes in consequence of frequent applications for them, probably on the part of the many tourists who pass through the city. He purchased a small line of men's shoes from a Paris agency and has had good success in disposing of them at 25 francs (\$4.82) per pair. The only unfavorable criticism offered at this shop is that the American shoes had too much of a curve in the instep; that the sole of the instep pressed against the foot. Models with the almost straight sole he sold rapidly, and finally disposed of the others. His experiment having succeeded, and the words "American shoes," advertised in his windows having proved attractive to customers, he has concluded to purchase again, and may perhaps add a line of women's shoes.

These circumstances, while very trifling in themselves, indicate that there is a nascent interest in this line of American merchandise, and that an experiment having succeeded on a small scale, might readily be pushed to success in a very much larger way.

The French tariff imposed on American foot wear is 48 cents per pair on boots for men and women, and 19.03 cents per pair on low shoes and slippers. While these rates are higher by about 10 cents per pair than those on similar merchandise imported, from most European countries, the difference, I think, may easily be overcome by our manufacturers.

If serious attempt is made to build up a boot and shoe trade in France, I trust that a special effort will be made to push high-class goods. There is at present no lack of cheap and clumsy ware, and the success of our people will finally rest upon their reputation for the production of comfortable, stylish, and finely finished shoes. Up to this time, France has been rather behind Great Britain and Germany in importing this class of merchandise from the United States, partly because French buyers are accustomed to having their boots made to order, partly because French shoes, and especially ladies' boots, are rather better than similar manufactures of other European countries, and partly because of the differential tariff which our manufacturers must pay. These impediments to trade are not sufficiently strong, however, either singly or combined, to stand in the way of success, if our manufacturers are disposed to make the effort.

The Malaga Almond Crop.—Consul Ridgely reports from Malaga, March 15, 1901:

Inquiries have been made from the United States as to the prospect of the coming almond crop in this district. It is considered too early here to speak with any confidence of the crop. Indeed, I am assured by experts that nothing positive can be said before the 1st of May. In so far, however, as one can vaguely judge at this time, the crop is fully as promising as at the same period of last year; but the winds of March and April are to come yet, and until they have passed nobody knows what the almond crop will be. Incidentally, I may state that it is likely the frost has done some damage in the neighborhood of Granada, but probably not to any great extent. Of last year's crop of almonds, many boxes still remain in Malaga unsold on account of the high prices demanded. This fact, perhaps, has influenced certain persons to assume that the almond crop this year will be small, but there is no valid reason for any such conclusion.

Exhibition in the Azores.—I am in receipt of an official letter notifying me that it is the intention of the authorities of this island to inaugurate a grand fair, or exhibition, in honor of the first visit of the King and Queen of Portugal to the Azores, says Consul George H. Pickrell, of St. Michael's. The official programme puts the date of their appearance in St. Michael's at July 1, 1901, and it is intended that the King will open the fair in person. It will last three weeks.

Undoubtedly, this will attract a large number of people from the other islands, and it seems to me that it would be an excellent opportunity to exhibit some of the many things for which we are celebrated.

Unfortunately, the plans of the fair association do not embrace buildings for the exhibition of foreign manufactures; but I am assured by the director, Dr. Aristides Moreira da Motta, that, upon proper application, space would be provided for such a building, should foreign exhibitors care to erect one. Dr. Motta

would be very glad to have an American exhibit, and the charges would be very small. Customs duties will be collected on all goods intended for the fair, but will be remitted at once upon proof of reshipment. No objection will be offered to selling goods in the fair, but delivery of goods sold cannot be made until after the close of the fair, and a charge of 5 per cent will be levied on all such sales.

As the heavier kinds of machinery enter very little into the wants of these people, I would think it advisable to limit the goods to be shown to the lighter forms, such as plows, cornshellers, hoes, shovels, rakes; besides carpenter, machinist, and blacksmith tools; bolts, nuts, locks, and other house furnishings; tin, sheet iron, wire, soaps, paper, oatmeal, etc., in packages, cotton and print goods, silks and novelties, men's and women's furnishings, leather, graphophones, and similar articles. Most of these things could be sold here, thereby reducing expenses.

My idea would be for a number of firms to combine and pool expenses and send agents here to superintend the exhibit. As lumber is very expensive and the people work very slowly, it would be a great saving if the building were gotten ready for erection in the United States; and if it were of tasteful design, suitable for a summer cottage, I am almost certain it could be sold here.

That such an exhibition would be well received, I am certain. There are here and in the other islands a large number of naturalized Americans who would advertise our goods. This will be the greatest event in the history of the islands for a century.

International Agricultural Exhibition at Prague.—Under date of March 15, 1901, Consul Hughes, of Coburg, reports as follows:

The Landwirtschaftliche Centralgesellschaft for the Kingdom of Bohemia is making arrangements for an agricultural exhibition, to take place at Prague from the 15th to 19th of May, 1901. Cattle, agricultural products, and agricultural tools and machines will be exhibited. The custom houses at the frontiers are ordered to have foreign exhibition goods passed through the head customs office at Prague, so that the goods may be noted for the refunding of duty on re-exportation. I would advise our American manufacturers of agricultural tools and machinery to make immediate arrangements for exhibiting their goods, which are vastly superior to those turned out by their continental competitors.

New Harbor in Norway: Mining Development.—German papers report that a new harbor is being constructed at the north of the Scandinavian Peninsula, for the chief purpose of shipping the immense quantities of iron ore found in Lapland. The iron mines of Gellivare and Luossavaara have been developed to such an extent within the last ten years that better facilities for export of the ore have become an urgent necessity.

The new harbor will be named Victoria Harbor, and its entire northern shore of more than half a mile will be used exclusively for the shipment of ore produced in the above-named mining districts.

The government of Norway has bought an extensive tract along the south side of the harbor.

The harbor will be constructed after the plans of that of Duluth, Minn. The total cost of the docks and buildings is estimated at \$800,000; the cost of the docks proper, at about \$650,000.

The plans for the new city to be built there are nearly completed, and many houses are built and some streets laid out already. Of late new iron deposits of enormous extent have been discovered in Lapland, and steps for developing them have been taken. A daily production of 5,000 tons of ore is expected. Some of these claims have been bought by a Belgian company.

Several English and German experts have lately been exploring this region for iron and other minerals, and important discoveries are said to have been made.

The laws of Norway are very favorable for mining enterprises, as the discoverer of a mineral deposit on public lands is at once entitled to exploit it. All he has to do is to give notice of his discovery and have such notice registered.—Richard Guenther, Consul-General at Frankfurt.

German Consular Representation in Central America.—Minister Merry reports from San José, March 6, 1901, the establishment at Managua of a German consulate-general, with jurisdiction over consulates in Salvador, Honduras, Nicaragua, and Costa Rica. The establishment of this office, says Mr. Merry, appears worthy of notice as an indication of the recognized German policy in the development of foreign commerce, and is also probably due to the impression that the construction of the Nicaraguan Canal in the near future will increase the importance of proper German representation in its vicinity. The extensive commercial interests of Germany in Central America, adds the minister, have suffered heavy losses during the past few years, resulting largely from the unfavorable condition of the coffee market in Europe and the United States; but German merchants have made such heavy advances to producers that it has become necessary to work out the commercial problem patiently and with increased investment, if necessary. The action of the German government set forth above is a proof of its increasing interest in Central American affairs.

Street-Car Heaters in Germany.—Under date of February 11, 1901, Consul Warner, of Leipzig, reports that there is great need for electric heaters in the street-cars of that city, the three electric street railways in and about Leipzig not having a single car which is heated either by electricity or coal on the coldest days in winter. Formerly, when horse cars were in use, they were heated by placing coals of fire in iron boxes; but, after several months' trial, the system was abandoned. It is not because there is no cold weather during the winter months, says the consul, that street cars in most of the cities of Germany are not heated, but because the city authorities do not compel the street-railway companies to make their cars comfortable, and, unless required to do so by law, they will not put themselves to this extra expense. Mr. Warner urges the introduction of American electric street-car heaters, but adds that, in order to meet with success, it will be

necessary, first of all, to convince the authorities of the fact that the health of the general public is greatly endangered by riding in unheated cars during the winter months.

American Cotton in Madagascar.—Under date of February 18, 1901, Consul Gibbs, of Tamatave, writes:

Mr. L. Delacre, of Tamatave, invites correspondence with manufacturers or agents in reference to American cotton cloths, especially the marks so well known in Madagascar—"Cabot" and "Massach setta." This request is significant, inasmuch as Mr. Delacre has long been one of the largest importers of French cottons here. Now that American cottons may be imported and sold cheaper in Madagascar than French cottons, despite the heavy duties, I am of the opinion that the time is not far distant when American cottons will capture this market again. To avoid delay, Mr. Delacre requests that all details as well as samples of cottons be sent him.

Substitute for Rubber.—The Department is in receipt of the following report from Consul Nelson, of Bergen, dated February 6, 1901, relative to the discovery of a cheap substitute for rubber:

"After having experimented for several years, a Copenhagen chemist has succeeded in producing a material called 'solcum,' which possesses qualities that will render it of the greatest importance to the caoutchouc industry. It is produced, it seems, from asphalt, and can be used for the manufacture of linoleum, rubbers, insulators, etc. It is also claimed that the material can be used as a paint, in all colors, and that it is absolutely waterproof.

Dynamite Fishing in New Brunswick.—A note from the British embassy, dated Washington, March, 14, 1901, informs the Department, at the instance of the Governor-General of Canada, that, in consequence of fishing by means of dynamite being carried on in the vicinity of Old Proprietor Lodge, off Grand Manan, New Brunswick, by both Canadian and United States fishing vessels, it has been necessary to take measures for preventing this illegal method of fishing. The officer commanding the fisheries-protection service has been instructed to seize and confiscate any vessels practising this destructive method within three miles of Old Proprietor Lodge.

American Tin Plates for France.—Under date of Nantes, March 12, 1901, Consul Brittain writes:

A prominent dealer in Nantes has requested the names of the leading manufacturers of black tin plates in the United States. This gentleman—Alfred Riom, Nantes, France—wishes the plates in a polished condition, ready for tinning. Correspondence should be conducted in French and prices submitted as soon as possible. The gentleman wishes to buy goods direct from the United States, if prices and terms are satisfactory.

Reduction of Wages of British Iron Workers.—Under date of February 19, 1901, Consul Marshal Halstead, of Birmingham, says that in view of the general depression in the British iron trade, it is announced that the employees of the Derby Iron Works Company have accepted a reduction in wages of 73 cents, this being, the Birmingham Daily Mail says, a 5 and 10 per cent reduction, respectively, for furnace men and laborers. "It is my understanding," adds Mr. Halstead, "that wages in all branches of the British iron industry have been higher the last year and a half than ever before."

French Purchase of Coal.—Consul Jackson, of La Rochelle, February 17, 1901, informs the Department that the French State Railway (Chemins de Fer de l'Etat) has recently purchased 100,000 tons of Cardiff coal at 16 francs (\$3.09) per ton, delivered, duty paid, on cars at the La Pallice Basin, La Rochelle, within twelve months. The consul adds that the exceedingly low price paid for this coal has caused much surprise both in France and in England.

English Demand for Blotting Paper.—Acting Consul-General Westcott writes from London, March 16, 1901, for the names of makers of American blotting paper, several inquiries having been made at that consulate-general by persons desirous of obtaining it. It has frequently been remarked by people calling here, he adds, that the quality of blotting paper in use in the office is far superior to anything of English make that can be obtained.

English in German High Schools.—Consul-General Guenther reports from Frankfurt, March 7, 1901, that the Emperor has decreed that the English language shall be taught in the high schools of Germany, in place of French, which shall hereafter be optional.

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- No. 1011. April 15.—Mineral Development in the Urals—American Loom in Austria—Coral and Pearl Fisheries of Colombia—Patent Medicines in Norway—A New Settlement of the Chinese Customs Duties—American Advertising Matter in Russia—Fancy and Leather Goods Exhibition in London.
- No. 1012. April 16.—Financial Conditions in Japan—Nottingham Electric Railway—Glass Exhibit at the Paris Exposition—New Classifications under the German Tariff—American Manufactures in Australia.
- No. 1013. April 17.—The Water Ways of Canada—Acetylene Gas for Light-Houses—Fireproof Stairs—Tariff on Machinery in Dutch India.
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- No. 1016. April 20.—Brickmaking in Formosa—Extinction of Fire Aboard Ship—Free Homesteads in Canada—Telephone in Liberia—Elberfeld-Barmen Suspension Railway—United States Rails in Nicaragua.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Corrosive for Warts.—As a practical corrosive for warts, Meuse recommends trioxymethylene, known by the name of paraform, according to the formula: Trioxymethylene 3 grammes, collodion 27 grammes. Paint on three times per day. The epidermis usually peels off readily after two or three days.—Süd. Apotheke Zeitung.

Salol Tooth Powder.

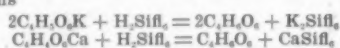
Salol 4 grammes
Lime phosphate 20 grammes
Lime carbonate 20 grammes
Magnesium carbonate 20 grammes
Sodium bicarbonate 15 grammes

Peppermint oil in suitable quantity.—Zanntechnisch. Ref.

Protection Against Slipping on Ice, Etc.—Let 50 grammes of thick turpentine, 200 grammes of colophony, 50 grammes of benzine and 250 grammes of alcohol stand in a bottle in a warm place until a dissolution of the turpentine and the colophony has taken place. With this solution coat the shoe soles several times and allow the liquid to soak in. This medium, which has been named "leather-sole fluid" by E. Soxhlet, also preserves the leather.—Praktischer Wegweiser.

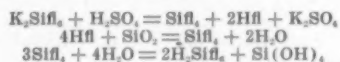
Coal Kindlers.—Composition: American rosin, dark, 60 parts, and shavings, turnings, cuttings and other wood waste 40 parts yield a durable mass. If less rosin is added the mass would crumble; if the addition of rosin is increased the kindler would burn badly and the superfluous rosin run through the grate. Hardwood turnings are most suited for the ordinary coal kindler. Thinner tablets for kindling fires are prepared from sawdust. Process: Heat the rosin in an iron kettle tapering down toward the bottom, to 120 degrees Réaumur (302° F.) until it becomes as thin as water, add the chips and stir until the latter have become evenly covered with rosin, hence have the appearance as though thinly varnished. The mass must not be lumpy but loose; one chip must not be attached to the other, which is attained by a sufficient temperature. The hot mass is now shoveled into iron molds, in which tablets and pieces are obtained by suitable notches; distribute the mass evenly and treat it with an iron hand roller until it has acquired a certain firmness. While the mass is still elastic, it is removed from the mold and placed on drying boards. As soon as the yet cohering plates have solidified, they are broken up into single tablets and wrapped in paper. For wholesale manufacture there are mechanical rollers for operation by hand or power, also mixing vessels with mechanical stirrer.—Technische Rundschau.

New Process for the Production of Tartaric Acid.—The method which is in use in almost all the factories of the world for the production of tartaric acid is the old one indicated by Scheele, with slight modifications. By the same, lime tartrate is first produced, which is then decomposed with sulphuric acid. The process is very slow, expensive, and only worthless by-products are obtained. G. Searlatti, therefore, proposes a new method, which permits of obtaining tartaric acid direct from the by-products and to recover the by-products again. He causes hydrofluosilicic acid to act upon crude tartar, which consists of potassium bitartrate and calcium tartrate, thus obtaining, according to the equations



tartaric acid and calcium tartrate, which remain dissolved, while the potassium fluosilicate separates out for the most part, since it is soluble in water only in the proportion of 1 to 825.

The percentage of calcium tartrate is determined by analysis, the calculated amount of sulphuric acid added (somewhat in excess) and concentrated. Next the clear liquid is decanted from the gypsum organic substances and last remains of the potassium fluosilicate and crystallization is effected. Hence potassium fluosilicate is obtained as a chief by-product, from which the hydrofluosilicic acid is regenerated by means of sulphuric acid according to the following equations:



—Neueste Erfindungen und Erfahrungen.

To Stain Furniture Brown.—Provide a tight room that can be closed, fit it with shelves, place the finished piece of furniture and its accessories in this room, laying the different parts on the shelves. In the center of the room set up a vessel containing unslaked lime; upon this pour sal-ammoniac and an equal quantity of water, and heat the whole over a moderate fire. This causes profuse vapors of sal-ammoniac to form, which stain the wood brown in a uniform and pretty manner. For waxing the stained articles, reddish wax is best employed. The best way would probably be to place the furniture and its different parts in the room at night, closing it so that no vapors can escape. Next morning the furniture is stained brown without any trouble. The work may, of course, also be done in daytime, but has to be conducted in a closed room, since the ammoniacal vapors have an unpleasant, though not injurious action on the organs of respiration.

For smaller articles, such as are made by the turner and carver, and which, owing to being pierced, are liable to warp, a large box, provided with some laths at the bottom or hooks, to lay in or hang up the articles to be stained, is sufficient. After staining the articles have only to be waxed, i. e., coated with wax dissolved in turpentine, rubbing the latter off again thoroughly with brushes and woolen rags to impart a nice dull luster outside of a handsome color. The size of the staining chamber or box, the length of time of the action, the quantities of lime and sal-ammoniac to be used, all depend upon the number and size of the objects to be stained, and require a trial, like all new methods. This small trouble, however, is repaid manifold, since the pieces do not have to be repeatedly wetted by the stain, and consequently do not require to be rubbed down several times, but issue ready stained from the room.—Deutsche Maler Zeitung.

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